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FINAL WORK PLANS PRELIMINARY ASSESSMENT/SITE INVESTIGATION OF SITE SS009

KANSAS CITY MO

12/25/1993

TETRA TECH

INSTALLATION RESTORATION PROGRAM (IRP)

PRELIMINARY ASSESSMENT/SITE INVESTIGATION OF IRP SITE SS009 RICHARDS-GEBAUR AIR FORCE BASE, MISSOURI

FINAL WORK PLANS

A. Work Plan
B. Field Sampling Plan
C. Quality Assurance Project Plan
D. Health and Safety Plan

25 December 1993

NOTICE

This report has been prepared for the United States Air Force by Tetra Tech, Inc. for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance of this report in the performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

PREFACE

Tetra Tech, Inc. is a contractor for the Preliminary Assessment/Site Investigation (PA/SI) of IRP Site SS009 at Richards-Gebaur Air Force Base, Missouri. This work will be performed for the Air Force Center for Environmental Excellence (AFCEE), F33615-90-D-4006, Delivery Order 0008.

This Work Plan describes proposed activities for the PA/SI of IRP Site SS009 at Richards-Gebaur Air Force Base.

Principal Tetra Tech personnel include Mr. Russell B. Krohn, who serves as Project Manager; Julie WestHoff, who serves as IRP Site SS009 Task Manager; and Ms. Linda Laughlin, who serves as Laboratory QA/QC Oversight Manager.

The work presented herein is to be accomplished between July 2, 1993 and September 30, 1994. Captain J. Bradley Beck, Air Force Center for Environmental Excellence, Environmental Restoration Division (AFCEE/ESB), is the Technical Project Manager.

Approved:

Russell B. Krohn

Russell B. Krohn, Associate Director

INSTALLATION RESTORATION PROGRAM (IRP)

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FOR

PRELIMINARY ASSESSMENT/SITE INVESTIGATION OF IRP SITE SS009 RICHARDS-GEBAUR AIR FORCE BASE, MISSOURI

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16 November 1993

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A. WORK PLAN

1.0 INTRODUCTION

This is the Work Plan for the Preliminary Assessment/Site Investigation (PA/SI) of Installation Restoration Program (IRP) Site SS009 at Richards-Gebaur Air Force Base, Missouri. This document describes planned activities associated with the PA/SI of IRP Site SS009, also known as the Fire Valve Area. The investigation of the Fire Valve Area will include a literature search to obtain background information; field investigations to define the nature and extent of contamination; conceptual site model to illustrate the nature and extent of contamination and the transport and fate of those contaminants; and a qualitative risk assessment to estimate the potential risk posed by the site to public health and the environment.

All the information in this Work Plan was prepared according to the May 1991 version of the Handbook to Support the Installation Restoration Program (IRP) Statements of Work, Volume I-Remedial Investigation/Feasibility Studies (RI/FS) (U.S. Air Force 1991) (hereinafter referred to as the Handbook); the U.S. EPA Guidance for Performing Preliminary Assessments Under CERCLA (P92-963303, September 1991); and Guidance for Performing Site Inspections Under CERCLA (EPA/540-R-92-021).

1.1 Description of the Air Force IRP

The objective of the U.S. Air Force IRP is to assess past hazardous waste disposal and spill sites at U.S. Air Force installations, and to develop remedial actions consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) for those sites posing a threat to human health and welfare or the environment. Over the years, IRP requirements have been developed so that the Department of Defense (DOD) complies with all federal laws such as the Resource Conservation and Recovery Act (RCRA); National Contingency Plan; and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

1.2 Description of Current Study

On July 8, 1993, Tetra Tech, Inc., was tasked by the Air Force Center for Environmental Excellence (AFCEE/ESR) under Contract No. F33615-90-D-4006, Delivery Order 008, to perform a PA/SI of the Fire Valve Area, IRP Site SS009 on Richards-Gebaur AFB. This Work Plan describes the activities that will be conducted as part of the PA/SI for the Fire Valve Area.

Richards-Gebaur AFB is an Air Force Reserve Base located in west-central Missouri, approximately 18 miles south of downtown Kansas City and 2.6 miles from the Kansas state line (Figure A-1). The Fire Valve Area, Site SS009, is located at the edge of the Civil Engineering Complex, directly behind (south side) Building 605 (Figure A-2). During excavation by an Air

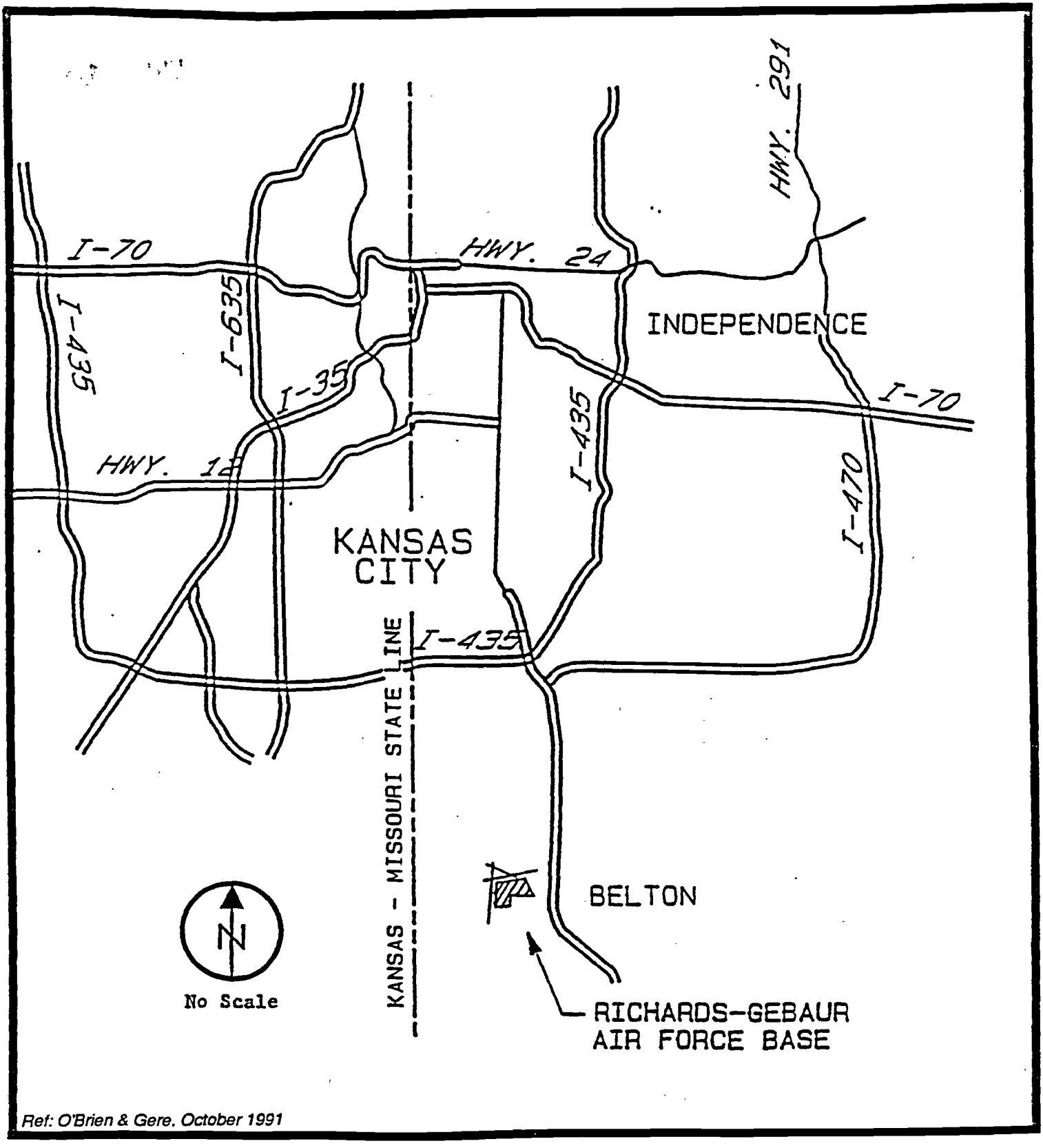

Figure A-1: Location of Richards-Gebaur Air Force Base, Missouri.

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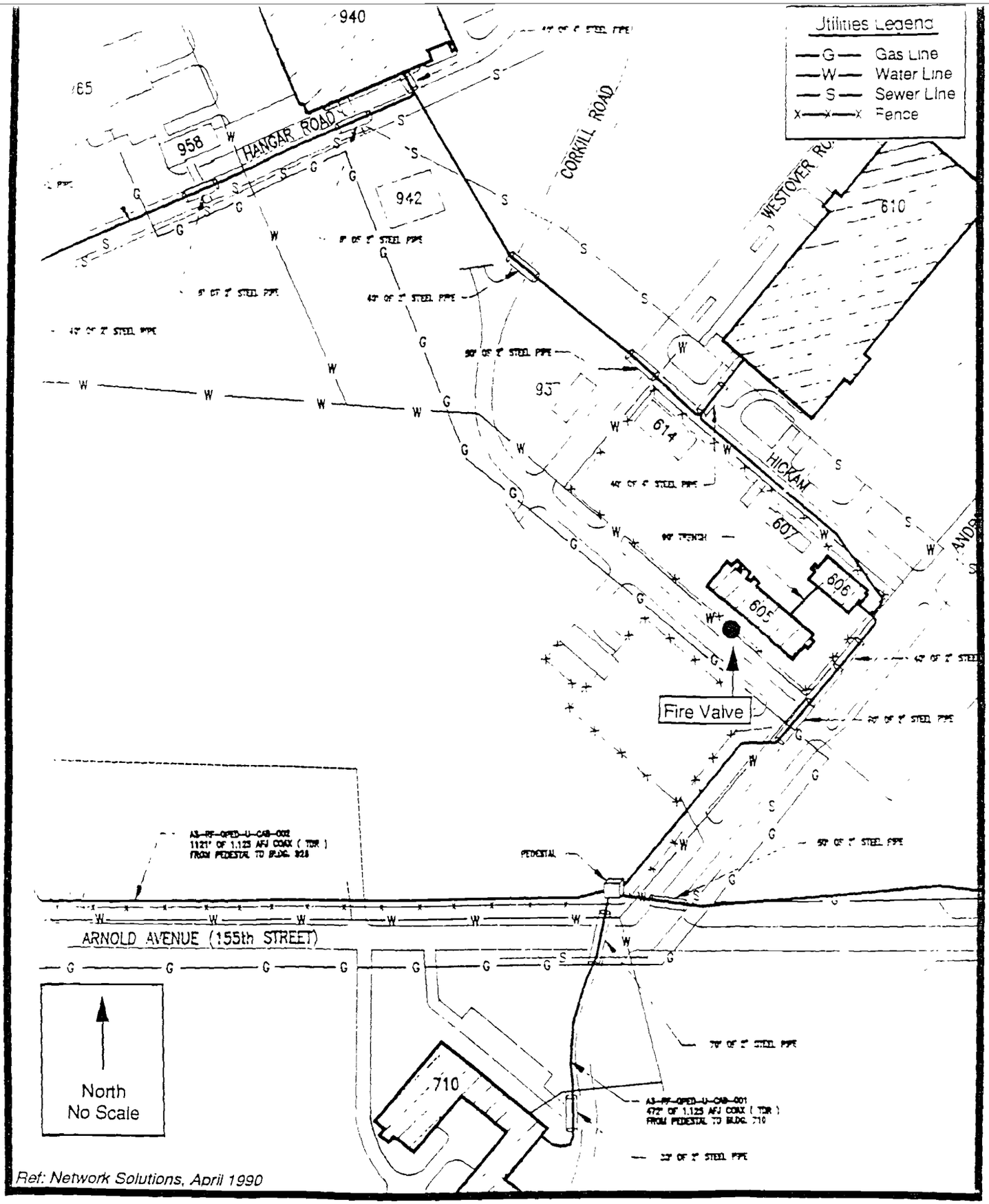

Figure A-2: Fire Valve Location, Richards-Gebaur AFB, Missouri.

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Force contractor in March 1992 to repair an underground water main valve, petroleum product was discovered. The trench soils were tested and contaminant levels exceeded the State of Missouri's cleanup action levels for Benzene/Toluene/Ethylbenzene/Xylene (BTEX) and Total Petroleum Hydrocarbons (TPH). The source of the petroleum discovered in the trench has not been determined. Approximately 10 cubic yards of soil was removed and the excavation was backfilled with clean fill.

1.3 Project Objectives

The purpose of this PA/SI is to determine the source of the petroleum contamination detected in the Fire Valve Area, Site SS009, define the nature and extent of potential contamination in the soil and groundwater, and identify potential threats to human health and the environment in relation to this site.

1.4 Subcontractors

JB Environmental Drilling will be subcontracted for the drilling and sampling of soil borings, and the installation and development of monitoring wells. Chemical analyses of soil and water samples will be performed by PACE, Inc. No other subcontractors have been identified at this time. At the appropriate time, Tetra Tech will provide notification to the Contracting Officer's Representative (COR) and the Richards-Gebaur AFB Point of Contact (POC) of any additional subcontractors that may be needed during the course of the PA/SI.

2.0 SUMMARY OF EXISTING INFORMATION

The following sections provide a summary of information currently available regarding Richards-Gebaur AFB. These sections include a brief summary of the AFB's history and its environmental setting.

2.1 Background Information

Richards-Gebaur AFB is an Air Force Reserve Base located in west-central Missouri, approximately 18 miles south of downtown Kansas City and 2.6 miles from the Kansas state line. The Base is bounded by the City of Belton on the east and south, and is surrounded by Kansas City to the north and west. Richards-Gebaur AFB is not on the National Priorities List (NPL) and has not entered into a Federal Facility Agreement (FFA).

In 1941, the land occupied by Richards-Gebaur AFB was acquired by Kansas City for use as an auxiliary airport (Grandview Airport). In 1952, the Aerospace Defense Command leased the airport from the city for air defense operations, and in 1953 the property (approximately 2,400 acres) was formally conveyed to the U.S. Government for establishment of an Air Force Base. The C-46 airlift aircraft were the original Air Force reserve aircraft stationed at the Base.

Conversion to C-119 and C-124 aircraft occurred in 1957 and 1961, respectively. In 1957, the Base was named Richards-Gebaur AFB.

Until 1970, the Air Defense Command (ADC) had the primary mission on Base. In 1970, the Air Force Communications Service (AFCS) relocated its headquarters from Scott AFB, Illinois to Richards-Gebaur AFB, and assumed command. In 1971, the C-124 reciprocating engine aircraft were replaced by C-130 aircraft. This conversion reduced industrial waste quantities produced at the Base (e.g., approximately half as much waste oil was generated with the C-130s). The AFCS moved back to Scott AFB in 1977, and Richards-Gebaur AFB came under the Military Airlift Command.

The number of active duty military and civilians at Richards-Gebaur AFB was reduced from a maximum of about 5,000 personnel during the active years of the Base to less than 500 full-time personnel. By September 1979, the majority of the operating support functions were transferred to Talley Services, Inc., a civilian contractor. The Air Force Reserve (AFRES) assumed operational control in October 1980. In 1982, Base mission changes resulted in the conversion to A-10 fighter aircraft from the C-130s, causing a substantial decrease in the quantities of waste oils, fuels, and solvents generated. The AFRES 442nd Fighter Wing currently has the primary mission on Base and they are equipped with A-10 Thunderbolt II aircraft.

The majority of the Base facilities (runways, taxiways) and properties were transferred to the Government Services Administration (GSA) in 1981, and an interim lease and joint use of the airport with Kansas City became effective. The excessed parcels were subsequently transferred by GSA for public and other military uses to the cities of Kansas City, Belton, and the Department of the Navy, and the Department of the Army. Base property at the present time comprises ~~848.34~~ acres as follows: ~~427.77~~ 428.22 acres in fee (including ~~244.12~~ acres of Richards-Gebaur AFB proper and 183.65 acres for the Belton Training Annex); and ~~420.57~~ acres in easements.

2.2 Topography and Surface Drainage

The topography of Richards-Gebaur AFB is gently rolling with an average elevation of approximately 1,000 feet above mean sea level. The regional terrain is characterized by a nearly level plain that has been incised by tributaries of the Missouri River, resulting in rolling hills with relative relief ranging from 50 feet to 150 feet. The base is situated on the south-central portion of a broad plateau known as the Blue Ridge, with the Blue River to the west and the Little Blue River to the east. The Blue River basin and the Little Blue River basin provide drainage for the area. Both rivers flow to the northeast into the Missouri River, located approximately 20 miles north of the Base. All Base drainage is located within the Little Blue River drainage basin, which ultimately flows to the Missouri River. Within this drainage basin, Base storm water flow is generally toward Scope Creek, which flows from south to northeast through the Base, as shown on Figure A-3.

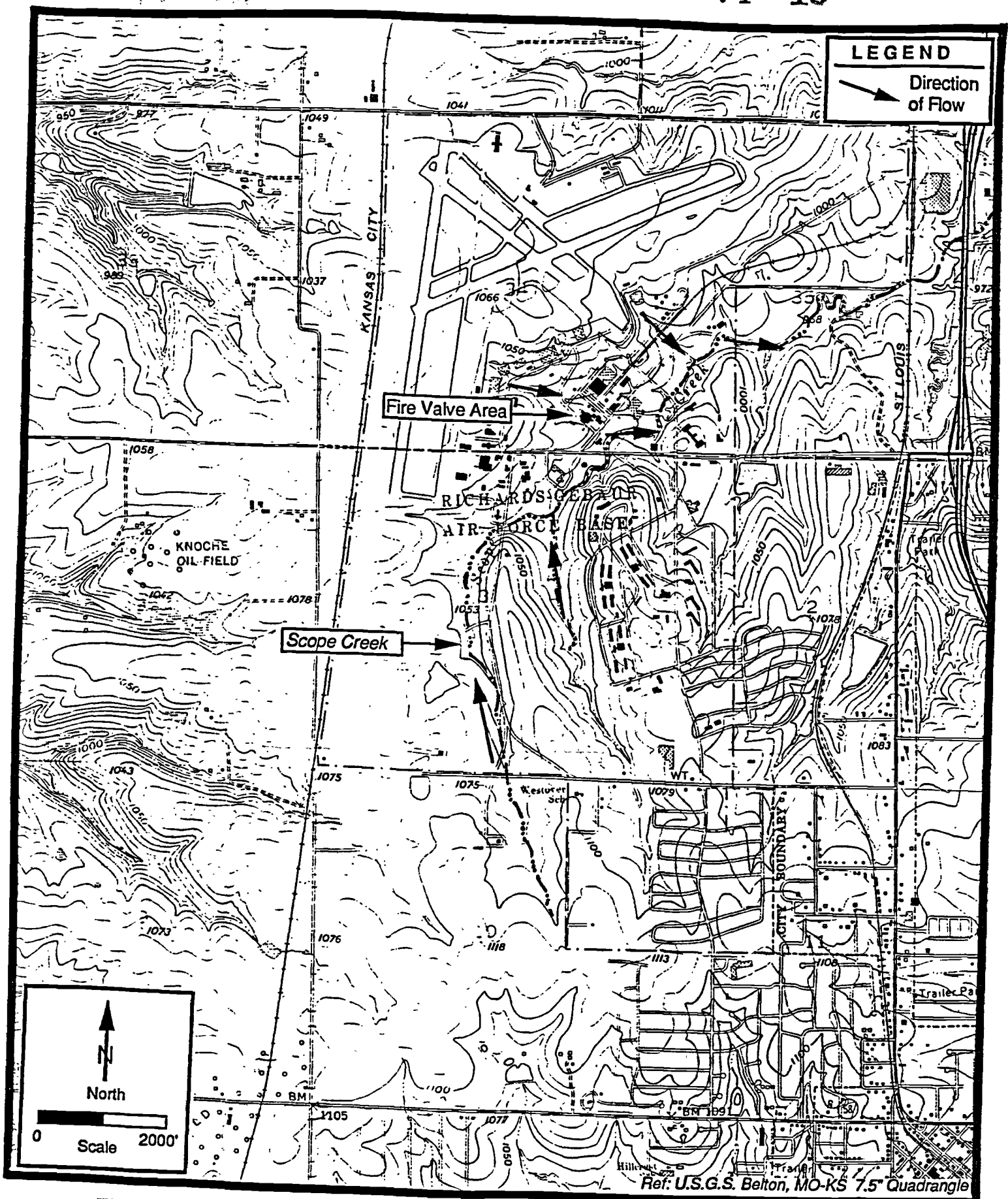


Figure A-3: Topography and Surface Drainage, Richards-Gebaur AFB, Missouri.

2.3 Geology/Hydrogeology

Richards-Gebaur AFB is located within the Osage Plains region of the Central Lowland physiographic province. The region is characterized by low relief, wide, maturely dissected uplands, and relatively steep valley slopes. The geology of the Base is characterized by very thin loess deposits over residual soils derived from the in-place weathering of the underlying limestones and shales. Rock outcrops are found along Scope Creek. Exposed rocks include the Argentine limestone, Lane shale, the Raytown member limestone of the Iola formation limestone, and the Chanute formation shale. The Lane formation is a grey micaceous shale of generally low permeability. The Raytown member of the Iola formation is a massive, fossiliferous, grey and brown limestone. Both units are Pennsylvanian in age. The Fire Valve Area appears to be underlain by the Lane formation, which is 25 to 40 feet thick at the AFB, shown on Figure A-4 (O'Brien & Gere, 1991). Based on previous investigations conducted on the Base, the depth to bedrock in the vicinity of the Fire Valve area could be approximately 15 feet below ground surface.

Regionally, the Richards-Gebaur AFB is located within the Osage-Salt Plains groundwater area of the Central Nonglaciated Plains groundwater region. The Osage-Salt Plains area is characterized by Pennsylvanian and Mississippian sandstone and limestone aquifers that yield water from shallow wells at low rates; wells deeper than 400 feet yield non-potable mineralized water.

The depth to groundwater across the Base is generally shallow (several feet to approximately 30 feet) and varies over short distances, possibly due to perched conditions. The depth to groundwater varies seasonally (seasonal high depth to water of approximately two to four feet below ground surface) but also varies with the topography, with groundwater being deeper in areas of higher topography. Normally, seasonally high water table elevations are observed in the spring and fall with low water table conditions occurring in the summer and winter.

2.4 Soils

According to the Soil Survey of Jackson County (SCS 1984), the soils at the Fire Valve Area belong to the Macksburg-Urban series, which is defined as being gently sloping, poorly drained silt and silt clay loams, covered in places by urban features and is typically 2 to 15 ft thick (Figure A-5). Permeability is moderate and surface runoff is medium. Organic matter content is moderate.

2.5 Climate

The following climate information was also obtained from the Soil Survey of Jackson County (SCS 1984). The consistent pattern of climate in Jackson County, MO and for Richards-Gebaur AFB is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and

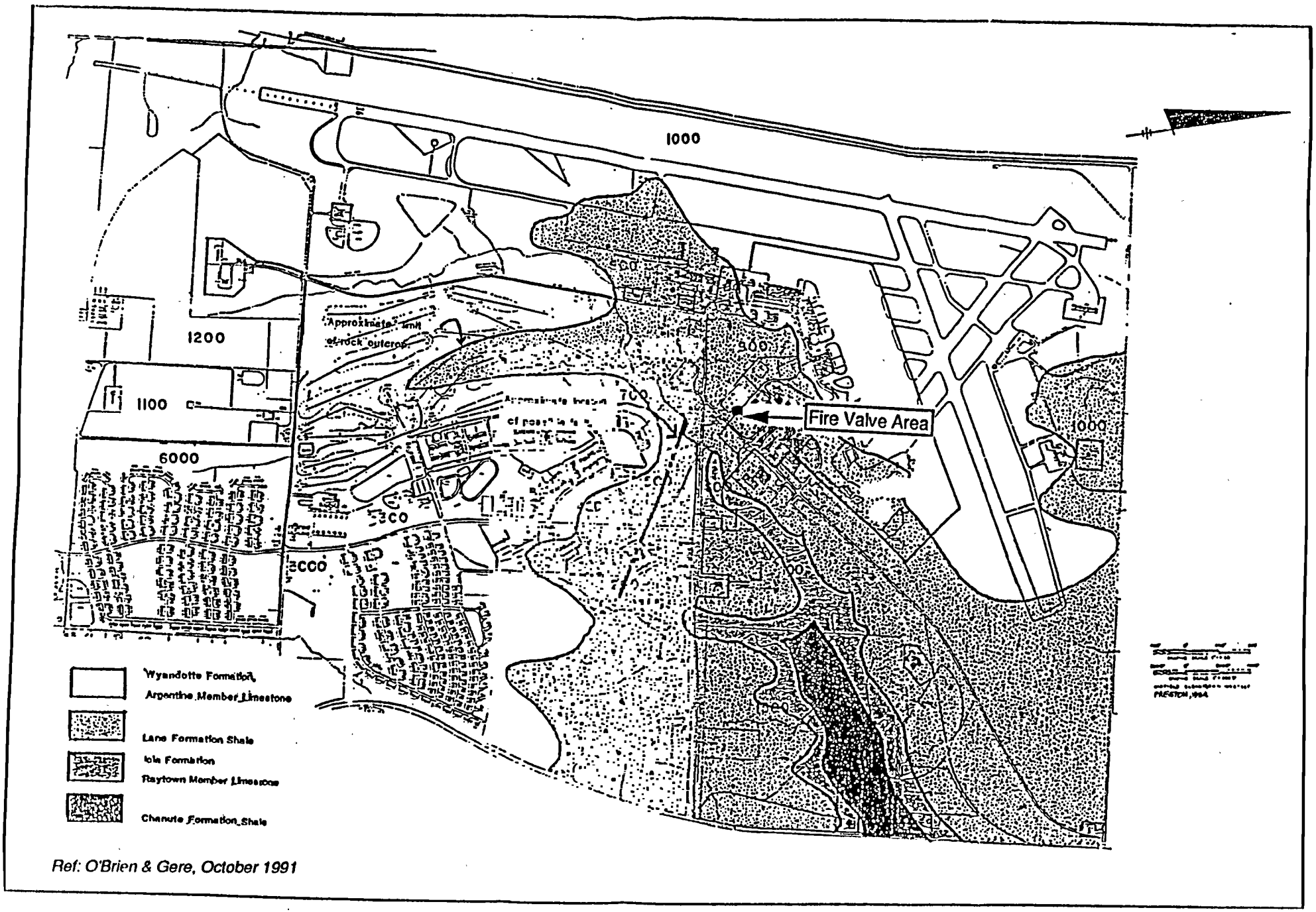


Figure A-4: Geologic Map, Richards-Gebaur AFB, Missouri.

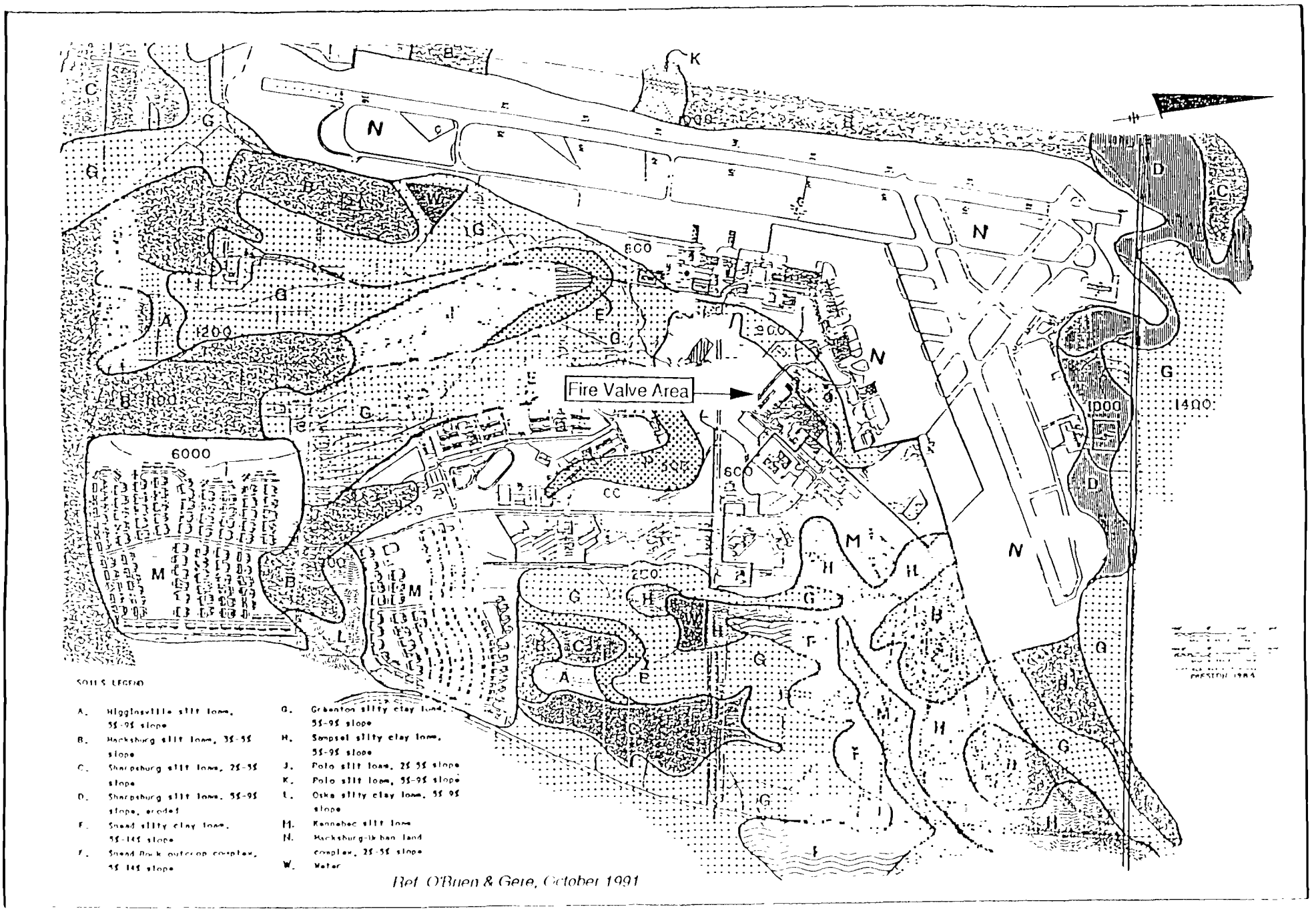


Figure A-5: Soils Map, Richards-Gebaur AFB, Missouri.

early summer. In winter, the average temperature is 33 degrees F, and the daily minimum temperature is 24 degrees. In summer the average temperature is 78 degrees, and the average daily maximum temperature is 88 degrees. The total annual precipitation is 35.75 inches, of which, 70 percent falls in April through September. The average seasonal snowfall is 22 inches. The average relative humidity in mid-afternoon is about 60 percent; humidity is higher at night, and the average at dawn is about 80 percent. Prevailing winds are from the south.

2.6 Contaminant Sources and Contamination

As stated previously, petroleum product was discovered in the Fire Valve Area during an excavation to repair an underground water main valve. Approximately 10 cubic yards of contaminated soil was removed from the area. The depth of the excavation was approximately five feet below ground surface. The soil was tested for BTEX and TPH, and the results of the analyses showed contamination exceeding the State of Missouri's action levels (listed in the Missouri Site Characterization Document, February 1991) for xylene and TPH, as shown on Table A-1. The source of the petroleum product has not been determined but will be investigated as part of the PA/SI. Two potential sources considered at this time are: 1) the petroleum is localized and resulted from a release that may have occurred when Building 605 was a part of the motor pool operation; and/or 2) the petroleum has migrated along the utility conduits (i.e., water or gas) from the abandoned 8-inch Petroleum, Oil and Lubricants (POL) pipeline to the Fire Valve area. The POL pipeline runs from the Bulk Fuel Yard to locations on the flightline for the purpose of fueling aircraft via a hydrant system. The hydrant system was installed in 1954 and taken out of service in the early 1970s. The location of the pipeline in relation to the Fire Valve Area is shown on Figure A-6.

Table A-1
Results of Soil Analyses from Fire Valve Area
Richards-Gebaur AFB
March 1992

Compound	Concentration	Missouri Action Level
Benzene	< 0.01 mg/kg	1 mg/kg
Toluene	2 mg/kg	5 mg/kg
Xylene	28 mg/kg	10 mg/kg
Ethylbenzene	4 mg/kg	10 mg/kg
TPH	24,870 mg/kg	200 mg/kg

Source: Kansas City Testing Laboratory, March 20, 1992.

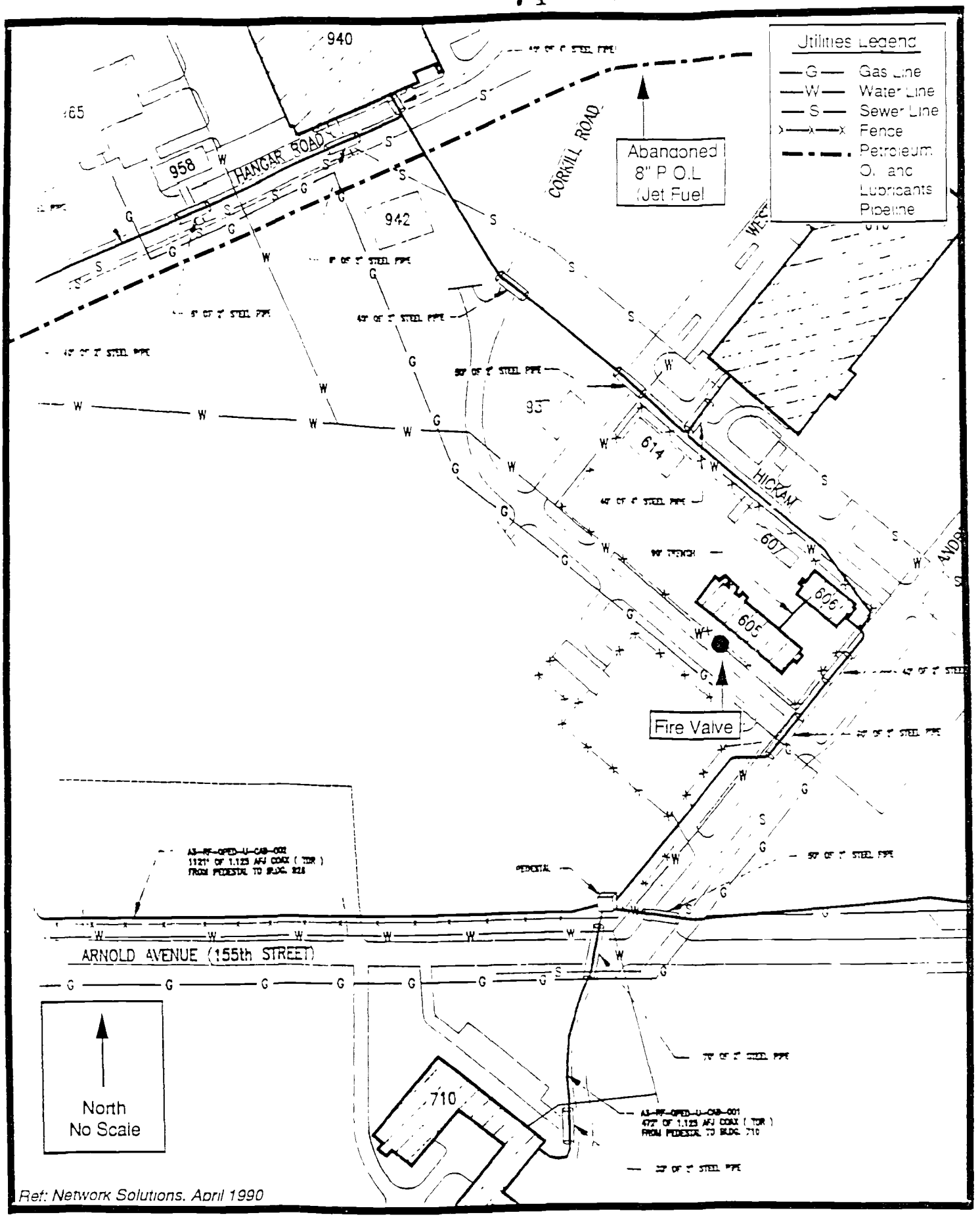


Figure A-6: Approximate Location of Abandoned Jet Fuel Pipeline, Richards-Gebaur AFB, Missouri.

2.7 Conceptual Site Model

The conceptual site model is to be used for identifying migration routes and potential receptors, by integrating geologic and hydrologic information, and providing the basis for a human health and ecological risk assessment. The conceptual site model is developed after a review of all available site information during the PA, and is then refined or revised with the inclusion of additional site data, whenever appropriate, throughout study. Based on the current information available, Table A-2 presents Tetra Tech's understanding of current site conditions as related to migration pathways and exposed population. The model will be revised after the completion of the PA/SI tasks. In addition, after field activities are conducted and more information is gained regarding the source of the contamination, a figure will be prepared indicating the exposure scenario most representative of the Fire Valve Area.

2.8 Applicable or Relevant and Appropriate Requirements (ARARs)

The CERCLA Compliance with Other Laws Manual describes how federal and state laws are identified and applied to remedial actions at hazardous waste sites. ARARs are identified by first determining whether the requirement is applicable, and if not, then whether the requirement is both relevant and appropriate. The guidance defines applicable requirements as "cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstances at a CERCLA site".

Relevant and appropriate requirements are defined as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while, not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site."

The determination that a requirement is relevant and appropriate involves a comparison of a number of site-specific factors, including the characteristics of the remedial action, the hazardous substances present at the site, or the physical circumstances of the site. In some cases, a requirement may be relevant, but not appropriate, given site specific circumstances; such a requirement would not be an ARAR for the site. Only portions of requirements may be relevant and appropriate for a remedial action; however, any requirement that is determined to be relevant and appropriate must be complied with to the same extent as if it were applicable.

There are three types of ARARs: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs are usually health or risk based numerical values or methodologies that are applied to site-specific conditions. These values establish the acceptable amount or

Table A-2· Preliminary Conceptual Site Model
Fire Valve Area, Site SS009, Richards-Gebaur AFB, Missouri

Site Desription	Soil Contaminants		Migration Pathway	Exposure Path/ Exposed Population	Preliminary Risk Evaluation
	Contaminant	Concentration			
Fire ValveArea Located on the south side of Bldg 605. During excavation to repair an underground water main valve, petroleum product was discovered in trench. Contaminated soil was removed.	Total Xylenes*	28 mg/kg	Leaching of contaminants from soil to groundwater; source data unknown; pathway incomplete.	Potential ingestion of contaminated drinking water; source data unknown; groundwater on site is not currently used for any purpose; pathway incomplete.	Groundwater To Be Determined
	TPH*	24,870 mg/kg			
			Contaminants spread by subsurface volatilization; source data unknown; pathway incomplete.	Potential exposure via inhalation; source data unknown; pathway incomplete.	Soil To Be Determined
			Contaminants spread by seepage into surface water; source data unknown; pathway incomplete.	Potential incidental ingestion, dermal contact, and inhalation, source data unknown; pathway incomplete.	Surface Water To Be Determined
			Soil; source data unknown pathway incomplete	Exposure to contaminated soil by utility workers via incidental ingestion, dermal contact, and inhalation; source data unknown; pathway incomplete.	

* Sample Event March 1992 Data not validated; concentrations exceed State of Missouri Action Levels.

concentration of a chemical that may be found in, or discharged to, the environment. The results of a risk assessment are used in setting cleanup goals that are protective of human health and the environment. As a starting point for setting cleanup goals, the risk calculations are developed using chemical-specific requirements. If there are no chemical-specific ARARs, then specified federal or state "to be considered" values are used. Examples of chemical-specific ARARs are the Federal drinking water standards. As stated in the CERCLA Compliance with Other Laws Manual, "there are, at present, only a limited number of chemical specific ARARs".

Location-specific ARARs set restrictions on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of special locations are floodplains, wetlands, historic places, and sensitive ecosystems.

Action-specific ARARs are technology or activity based requirements or limitations on actions taken with respect to hazardous wastes. The requirements are prompted by the particular remedial activities that are selected to accomplish a remedy. Action-specific requirements do not in themselves determine the remedial alternative but indicate how a selected alternative must be achieved. Examples of action-specific ARARs are RCRA regulations for waste treatment, storage, and disposal.

The potential ARARs identified for the Fire Valve Area are described in the following sections. It should be noted that additional ARARs may be identified in the future after the PA/SI tasks are completed.

2.8.1 Chemical-Specific ARARS

The chemical-specific ARARs set levels that are considered protective of human health and the environment for the chemicals of concern in the site media, or indicate acceptable levels of discharge for those chemicals, if discharge occurs as part of a remedial activity. If there is more than one requirement that is an ARAR for a chemical, then the remedial activity must meet the more stringent requirement.

The media of potential concern, identified at this time for the Fire Valve Area are the soil and potentially, the groundwater. The surface water may be considered a route of exposure for contaminants after further investigations. The potential contaminant of concern for the soil and groundwater identified to date is petroleum. At present, no federal chemical-specific ARARs for soils and sediments have been promulgated. Table A-3 provides federal drinking water standards that are potential ARARs for the site's groundwater.

RCRA

The Solid Waste Disposal Act (SWDA) was amended by the RCRA and the Hazardous and Solid Waste Amendments of 1984. These acts, and the regulations promulgated to enforce them,

Table A-3: U.S. EPA and State of Missouri Water Standards, Criteria, and Guidelines.

Chemical	U.S. EPA Drinking Water Standards		Non-potable Groundwater State of Missouri (c) (ppb)
	MCL (a) (ppb)	MCLG (b) (ppb)	
Benzene	5	0	50
Toluene	1,000	1,000	150
Ethylbenzene	700	700	320
Xylenes	10,000	10,000	320
Total Petroleum Hydrocarbons	-	-	10,000

Notes:

(a) U.S. EPA Maximum Contaminant Level in Drinking Water

(b) U.S. EPA Maximum Contaminant Level Goal for Drinking Water

(c) LUST Non-potable groundwater cleanup levels.

establish a comprehensive program, known as the RCRA program, to control the generation, transport, and disposal of solid and hazardous waste. Because RCRA regulates all types of hazardous waste activities and is generally the most stringent federal regulation for any activity, its conditions may be ARARs.

To determine whether the RCRA regulations are applicable at the Fire Valve Area, the determination first has to be made that the wastes are solid wastes (regulated by Subtitle D of the SWDA), because all RCRA hazardous wastes are considered a subset of solid waste. The petroleum contaminated soils at the Fire Valve Area meet the definition of solid waste as defined in 40 CFR 257. The next step is to determine whether the wastes at the Fire Valve Area are RCRA hazardous wastes. 40 CFR 261 defines which solid wastes are RCRA hazardous wastes; according to 40 CFR 261.4(b)(10), petroleum contaminated media and debris that fail only the toxicity characteristic (TC) and are subject to the corrective action requirements under 40 CFR 280, underground storage tanks, are excluded from the definition of hazardous wastes. It is not known whether the petroleum contaminated media at the Fire Valve area fails the toxicity characteristic. ~~It is also not know if the source of the contamination is from a LUST.~~ If the contamination is from the above ground tanks in the POL area, then materials from Non-Subtitle I tanks (e.g., above-ground tanks) are not deferred from the TC requirement. Additional information will be gathered during the PA/SI to determine if the petroleum waste is regulated under RCRA.

Superfund

Section 104 of Superfund authorizes the federal government to respond to a release or threatened release of hazardous substances or pollutants or contaminants. It is important to note that the definitions of hazardous substances and pollutants or contaminants specifically exclude petroleum, including crude oil, including the hazardous substances, such as benzene, that are indigenous in those petroleum substances. Therefore, the petroleum wastes at the Fire Valve area may not be regulated under Superfund.

State of Missouri

Missouri regulations that are more stringent than or supplement federal standards are also potential ARARs. The State has promulgated Leaking Underground Storage Tanks (LUST) Corrective Action Cleanup Goals for soil contamination resulting from a release of petroleum hydrocarbons from USTs. These values (25 ppm TPH, 1 ppm BTEX, and 0.5 ppm Benzene) are not cleanup levels but are used to determine if a release has occurred. While the source of contamination at the Fire Valve Area is not known, it is possible that a LUST located in the immediate area or along the utility corridor contributed to the petroleum contamination; therefore, these action levels may be considered ARARs. In addition, the State has generated soil cleanup levels for BTEX and TPH based on site features (Table A-4). Non-Potable Groundwater Cleanup Guidelines have also been established for BTEX and TPH that may also

Site Features	Score 15 if True	Score 10 if True	Score 5 if True	Score 0 if True
Groundwater potable?	No	Unknown	Poor	Yes
Depth to groundwater?	> 100 ft	51-100 ft	25-50 ft	< 25 ft
Natural fractures present?	None	Unknown	Present	Predominant
Man-made vertical conduits?	None	Unknown	Present	Predominant
Man-made horizontal conduits?	None	Unknown	Present	Predominant
Coarse soil or sand present?	None	Unknown	Present	Predominant
Water wells nearby?	> 1000 ft away	501-1000 ft away	100-500 ft away	< 100 ft away
Background levels present?	Above action levels	Unknown	Below action level	Nondetectable
Subtotals				
			Total Score =	

Soil Cleanup (ppm)				
Total Score	101-120	71-100	41-70	40 or less
BTEX =	2/10/50/50	1/5/10/10	0.5/1/2/2	B+T+E+X < 2
TPH =	500	200	100	50

Ref: MDNR, Underground Storage Tank Closure Guidance Document, January 1992.

Table A-4: MDNR Leaking Underground Storage Tank Soil Cleanup Guidelines for Undisturbed Soil.

be relevant and appropriate to the site. These values are presented on Table A-3. The State of Missouri has established these groundwater cleanup levels for LUST sites that have impacted groundwater through a release. If the groundwater is being used for drinking water, the cleanup standard for benzene becomes more stringent at 5 ppb.

In order to expedite the cleanup of hazardous waste sites on Department of Defense (DOD) installations within the State of Missouri and ensure compliance with the applicable laws and regulations of the State, DOD and Missouri Department of Natural Resources (MDNR) entered into an agreement known as the Department of Defense and State Memorandum of Agreement (DSMOA). Under the DSMOA, MDNR plans to review documents and activities produced as a result of efforts conducted by the DOD to identify and remediate uncontrolled hazardous waste/substances sites. As part of MDNR's Scope of Work, they are to identify and explain the State's ARARs. The information obtained from the State of Missouri regarding ARARs will be incorporated into the PA/SI report, as appropriate.

2.8.2 Location-Specific ARARs

Location-specific ARARs are utilized for the protection of certain locations, such as floodplains, wetlands, or sensitive habitats. As stated previously, these ARARs would restrict the concentration of a hazardous substance that may be disposed in a location, or restrict the remedial actions conducted at a location. No location-specific ARARs have been identified for the Fire Valve Area at this time; however, wetlands are present on the Richards-Gebaur AFB.

Wetlands are defined by the U.S. Army Corps of Engineers as "those areas that are inundated or saturated by surface or groundwater at frequency and durations sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils". The majority of jurisdictional wetlands in the United States meet three wetland delineation criteria (hydrophytic vegetation, hydric soils, and wetland hydrology) and are subject to Section 404 of the federal Clean Water Act. Areas that are periodically wet but do not meet all three criteria are not jurisdictional wetlands. Areas that have been disturbed or that are classified as problem area wetlands, but do not meet all three criteria as a result of natural or man-induced reasons, are still considered wetlands. Wetlands present on the Richards-Gebaur AFB meet the wetland delineation criteria.

The wetlands are located along natural drainages within the region. One wetland area has been identified east of the corrosion control building and is characterized as wooded with open patches of sedges. The other wetland area is adjacent to the POL tank farm and is dominated by cattails with intermittent patches of black willow where surface flow is reduced.

2.8.3 Action-Specific ARARs

Action-specific requirements are established for the selected remedial alternatives for a site. They may determine performance levels, actions, or technologies and certain levels for discharged or residual contaminants. Potential action-specific ARARs include, among others, Occupational Safety and Health Act (OSHA), Clean Air Act, Hazardous Materials Transportation Act, Solid Waste Disposal Act, and Missouri regulations. Action-specific ARARs will be identified and evaluated for their applicability during the course of the PA/SI.

2.9 Data Needs

As stated previously, the objective of this PA/SI is to determine the source of the petroleum contamination detected in the Fire Valve Area, Site SS009; define the nature and extent of potential contamination in the soil and groundwater; and identify potential threats to human health and the environment in relation to this site. The data needed to characterize the site, complete the conceptual site model, and better define the ARARs will be obtained by conducting a file review of existing information; this would contribute to the understanding of the source of contamination. Limited information has already been obtained from the Richards-Gebaur that would indicate two potential sources for the petroleum contamination found. One source could be a localized spill that may have occurred in the past when the building was used for motor pool operations. The other source could be from underground pipelines that contained jet fuel in the past and may have leaked. Utility maps of Richards-Gebaur indicate that jet fuel pipelines appear to intersect underground utility lines (i.e., gas, water, etc.), which would create a potential conduit for the jet fuel to migrate.

In order to determine whether the spill is localized or extends beyond the Fire Valve Area, a field investigation is proposed that involves drilling soil borings and collecting soil samples in the immediate area of the site, and then directing the field sampling effort to follow the utility conduits. Soil samples would be analyzed by a field gas chromatograph (GC) to assess volatile organic contamination. A percentage of the soil samples will be collected for laboratory analyses to determine concentrations of compounds (volatile organic compounds, semi-volatile organic compounds, and total petroleum hydrocarbons).

In addition to a file review and a field effort to identify the source and extent of contamination, the potential for groundwater contamination will be assessed. If it appears that the contamination was localized and that the interim removal action of 10 cubic yards of soil was adequate, a groundwater monitoring well will be installed and sampled for volatile organic compounds, semi-volatile organic compounds, and total petroleum hydrocarbons to verify that the groundwater was not contaminated from this site. In the event that groundwater contamination is suspected, additional monitoring wells would be required to delineate the nature and extent of contamination and would be beyond the scope of this PA/SI.

Potential receptors will be identified due to their existence in contaminant migration pathways. Potential groundwater and surface water and direct contact pathways will be investigated to determine whether there are human receptors within the affected area. If no permanent or transient receptors exist for a site or its affected area, no further action is appropriate. All potential receptors (present and future) that may come into contact with the contamination will be identified.

3.0 PRELIMINARY ASSESSMENT/SITE INVESTIGATION TASKS

This section describes the tasks that will be conducted according to the requirements for conducting PA/SI in the following U.S. EPA guidance documents: Guidance for Performing Preliminary Assessments Under CERCLA (PB92-963303, September 1991); and Guidance for Performing Site Inspections Under CERCLA (EPA/540-R-92-021, September 1992).

3.1 Purpose and Scope of the PA/SI

The purpose of the PA/SI, specifically, is to assess the immediate or potential threat the petroleum contaminated media at the Fire Valve Area poses to human health and the environment, and to collect samples to determine the nature and extent of contamination on site to support a decision regarding the need for further action.

3.2 Data Collection

Data collection activities will be in the forms of a literature search and field investigation. Discussed below are the elements of the literature search, which is conducted to identify releases of hazardous substances from the site and the potential exposure of targets to released substances.

3.2.1 File Review

Documents of particular interest during the file review will include site sketches, utility maps, inspection reports, aerial photographs, notification forms, waste hauling manifests, analytical sampling results, previous investigation reports, and records of violations. These documents will aid in the identification of source types, locations, quantities of waste generated and/or disposed, past environmental impacts, targets, and possible releases. Additional background and environmental setting information will be obtained, as well as information to determine whether the site is under federal or state authority.

Personnel interviews will also be conducted with civilian and military personnel currently working at Richards-Gebaur AFB to gather additional information regarding past and present hazardous material and waste management practices. If necessary, former civilian and military Richards-Gebaur AFB personnel will also be interviewed. Of particular importance will be

identifying personnel directly involved with the discovery and removal of petroleum contaminated soil in the Fire Valve Area, which occurred in March 1992. Personnel who previously worked in the Motor Pool operations could also be of assistance in determining potential sources.

3.2.2 Source Characterization

The type of petroleum product detected in the Fire Valve Area will be investigated during field activities to determine whether it is gasoline, jet fuel, diesel, etc. Identification of the type of petroleum product will aid in source identification. Currently, there are two possible scenarios concerning the source of the petroleum contamination. One source could be a localized spill that occurred in the past when the building was used for motor pool operations. The other source would be from underground pipelines that contained jet fuel in the past and may have leaked. Utility maps of Richards-Gebaur indicate that jet fuel pipelines appear to intersect underground utility lines (i.e., gas, water, etc.), which would create a potential conduit for the jet fuel to migrate.

3.2.3 Hazardous Waste Quantity

An estimation of the quantity of contaminated media will be completed after field activities have been conducted. Approximately 10 cubic yards of contaminated soil were removed by Richards-Gebaur AFB in March 1992 when the site was originally discovered.

3.2.4 Groundwater Targets

As part of the evaluation of the groundwater pathway, two factors are considered: Likelihood of Release, and Targets. The field effort will aid in the determination of a release or suspected release to the groundwater beneath the site. The principal concern with the groundwater system is the threat posed to drinking water and to populations relying on groundwater as their source of drinking water. Therefore, the target evaluation will involve identifying drinking water wells and their associated users within a four-mile radius around the site, as stated in the Guidance for Performing Preliminary Assessments Under CERCLA (PB92-963303, September 1991). A survey of drinking water supply systems and the number of people they serve will be performed In the event that a release is suspected, the primary and secondary target populations and the location of the nearest drinking water well will be identified. Use of groundwater resources for purposes other than drinking water will be determined. Additional information about the geology, hydrogeology, aquifers, and drinking water supply to the surrounding area will be incorporated into the study. In the event that the investigation is conducted under the MDNR's LUST guidelines, then the identification of drinking water wells and water supply systems and their populations within a one-mile radius of the site will be conducted. Because the source of the contamination is not known at this time, the type of investigation (i.e., MDNR LUST or PA) will follow that of a Preliminary Assessment.

3.2.5 Surface Water Targets

As part of the evaluation of the surface water pathway, two factors are considered: Likelihood of Release, and Targets. The field effort will aid in the determination of a release or suspected release to the surface water from the site. Although the source of contamination in the Fire Valve Area is unknown, the utility corridor is a suspected source area and it intercepts the drainage system on site. Therefore, it is suspected that release of a contaminant to surface water could occur with the potential to threaten drinking water supplies, human food chain organisms, and sensitive environments. As required in the guidance document Performing Preliminary Assessments Under CERCLA (PB92-963303, September 1991), the intake supplying drinking water, fisheries, and surface water sensitive environments within a 15-mile target distance limit will be identified and evaluated, after which, primary and secondary targets will be determined. The drinking water intake closest to the probable point of entry to the surface water is identified as an indicator of the magnitude of the threat the site may pose to surface water users. Other resources, primary and secondary target fisheries, and primary and secondary target sensitive environments are also identified as part of the surface water target investigation.

3.2.6 Soil Exposure Targets

The soil exposure pathway assesses the threat to human health and the environment by direct exposure of contaminants and areas of suspected contamination. The pathway differs from the migration pathways in that it accounts for contact with in-place hazardous substances at the site, rather than migration of substances from the site. The PA evaluation of the soil exposure pathway considers likelihood of exposure and targets. Targets are based on populations located on or within 200 feet of the site, and those populations within the surrounding area coming into contact with the site. For the Fire Valve Area, the potential target population identified to date are utility workers who excavate around the water line for maintenance purposes. No other population would be exposed to the potentially contaminated soils from this site, based on the current information. After the facility is closed, there is the potential for exposure to populations if activities on the property are different from those currently occurring.

3.2.7 Air Targets

As part of the evaluation of the air pathway, two factors are considered: Likelihood of Release, and Targets. The likelihood of a release of the contaminants from the site to the air is very slim to none. Therefore, target populations and sensitive environments will not be identified, based on the current information known on this site.

3.3 Site Reconnaissance

The purpose of the reconnaissance is to visually observe the site and its environs and to collect additional information to assist in the PA evaluation. This section describes the activities to be conducted by Tetra Tech as part of the site visit.

3.3.1 Source Characterization and Target Identification

The site visit will entail trying to identify and characterize potential source areas A detailed description of the Fire Valve Area including location, dimensions, and evidence of containment will be noted. The location of onsite wells and sensitive environments will also be determined. Because direct contact threats are limited to utility workers, target populations (e.g., schools, residences, and number of employees) will be identified within 200 feet of the site.

3.3.2 Additional Data Collection

During the site visit, facility files will be reviewed and interviews of site workers conducted, as appropriate, to supplement information already obtained by Tetra Tech during past site visits Documents that provide information on types and quantities of waste produced and/or deposited, any waste management records, and past disposal practices, as well any past environmental problems associated with the site or along the utility conduits will be researched During interviews, questions concerning past spills, health problems encountered by workers in buildings adjacent to the Fire Valve area, or complaints by workers will be considered.

3.3.3 Site Sketch and Photodocumentation

As part of the site reconnaissance, important physical features regarding the site will be noted and photographed. These features include, among others, locations of potential source areas, distances from sources to major site structures, locations and distances from sources to all targets (e.g., wells, surface water bodies, sensitive environments), significant site features, and the drainage pattern and overland flow route to surface water.

All photographs taken during the site visit will be documented in sequential order in a field logbook. The number of the photograph, date and time taken, camera direction, type of camera, and detailed descriptions will be recorded for each photograph.

3.3.4 Offsite Reconnaissance

The offsite reconnaissance will involve the following activities, if appropriate verification of target locations close to the site, gathering additional information concerning the overland flow route to surface water, and determining if there are affected land uses in the vicinity of the site

3.3.5 Emergency Response Consideration

Any conditions encountered during the site reconnaissance and field activities that may warrant immediate or emergency action will be forwarded to the Contracting Officer's Representative and Richards-Gebaur Base Point of Contact immediately. As noted in the Statement of Work for this site, following telephone notification, a written notice with supporting documentation (e.g., laboratory results and field data) will be prepared and delivered within three days. Upon request from the Air Force, the appropriate raw laboratory data will be submitted within three weeks of the telephone notification.

Site conditions that may require immediate action include, but are not limited to the following: threat of fire and/or explosion, threat of direct contact with hazardous materials, threat of a continuing release of hazardous materials, and threat of drinking water contamination.

3.4 Sampling Activities

As stated previously, the objective of the sampling activities will be to collect data in order to determine the nature and extent of contamination on site to support a decision regarding the need for further action. The auger, borings, or monitoring well will be placed so that the following information can be secured: the identity of the hazardous substances present, determination of whether hazardous substances are being released to the environment, and whether hazardous substances are impacting specific targets. Information obtained to date has been utilized to streamline the field investigation so that it focuses on determining the source of the petroleum contamination found in the Fire Valve Area. If, during the file review and site visits, information indicates source areas other than those suspected (i.e., motor pool or utility conduits), then the appropriate personnel will be contacted and the field effort may require some adjustments.

The specifics concerning field sampling and analyses are presented in detail in Section B - Field Sampling Plan and Section C - Quality Assurance Project Plan of this report. A Health and Safety Plan has also been prepared for the field activities and is found in Section D of this report.

3.5 Project Management

The Quality Assurance Project Plan (Section C) describes in detail the organization, functional responsibilities of key staff, and lines of communication for activities conducted during this project.

4.0 REPORTING REQUIREMENTS

The scope and content of reports to be submitted during the PA/SI of the Fire Valve Area, Site SS009 are discussed in this section.

4.1 Work Plan

This Work Plan describes all phases of the work planned and includes the following: investigation objectives, ARARs, schedule of activities, a Health and Safety Plan, a Field Sampling Plan, and a Quality Assurance Project Plan. Prior to completing the working draft, a Work Plan Outline was provided to the Air Force for approval.

4.2 Technical Report for the PA/SI

The Technical Report will summarize the findings of the PA/SI activities, and present conclusions and recommendations for future efforts regarding the Fire Valve Area. The report will follow the outline provided in Section 4.0 of the Handbook, as appropriate In addition, the "Potential Hazardous Waste Site Preliminary Assessment Form" (OMB Approval Number 2050-0095) will be completed and included in the Technical Report. A copy of the form is provided in Appendix A-1. Prior to completing the working draft Technical Report, a Technical Report Outline will be provided to the Air Force for approval.

4.3 NFA Decision Document

A No Further Action Document will be prepared if it is determined that the site requires no further action. The decision document will be in the form of an application to terminate the process.

4.4 Analytical Data ITIR

All analytical data, including Quality Control results and cross reference tables, will be submitted in an Informal Technical Informational Report (ITIR). The format provided in Section 4 of the Handbook will be followed to complete this report.

4.5 Project Definition ITIR

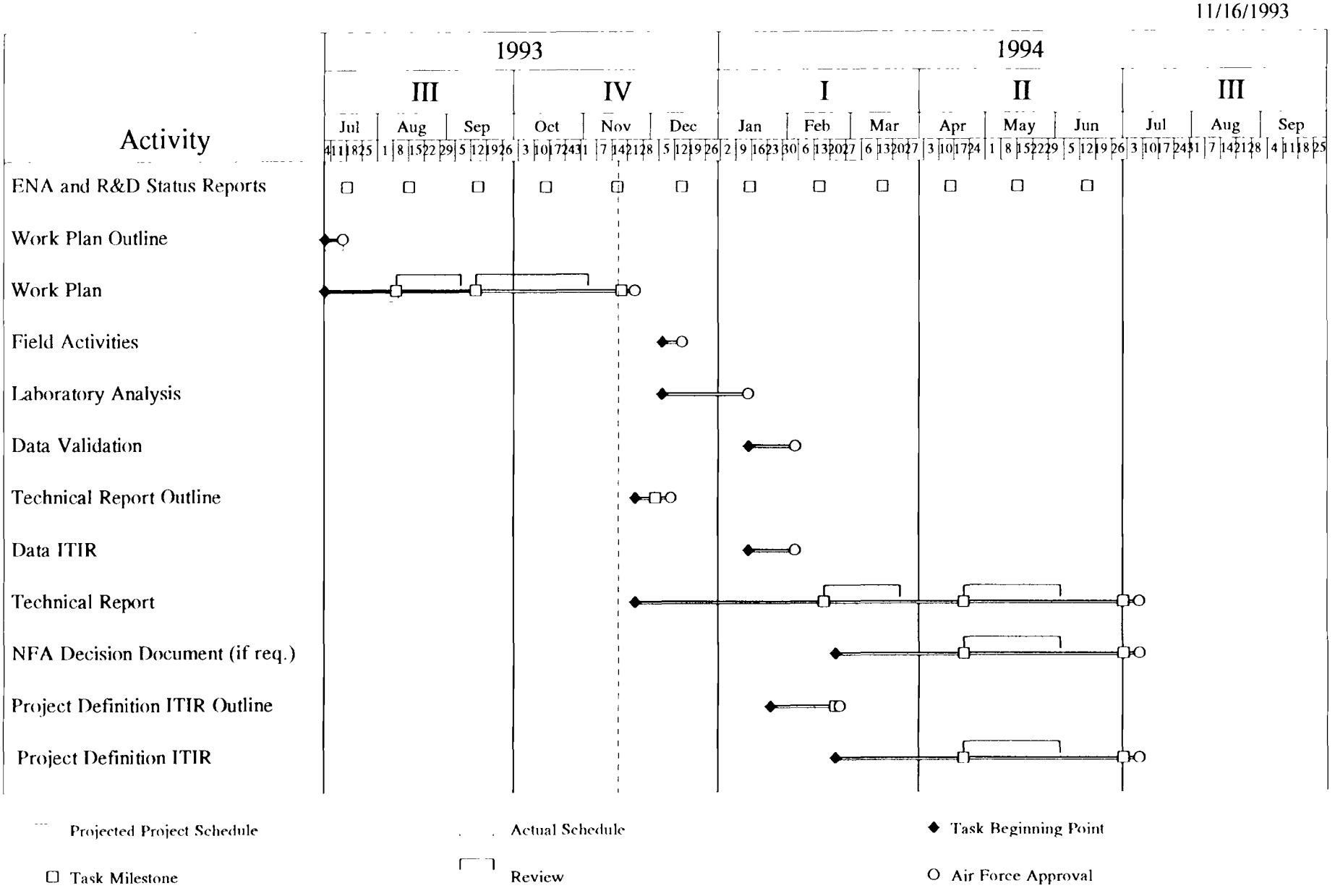
A Project Definition ITIR will be prepared, if requested, by the Contracting Officer's Representative for the Fire Valve Area, Site SS009. The document is to contain, at a minimum, a Site Characterization Summary and all available qualitative and quantitative information necessary to define requirements for site remediation. Prior to preparation of this report, an annotated outline will be provided to the Air Force for approval.

5.0 PROJECT SCHEDULE

Figure A-7 shows the projected PA/SI schedule of activities for the Fire Valve Area, Site SS009.

Figure A-7

Projected Schedule for IRP Site SS009 at Richards-Gebaur AFB, MO



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APPENDIX A-1

Potential Hazardous Waste Site Preliminary Assessment Form

OMB Approval Number: 2050-0095
Approved for Use Through: 1/92

EPA Potential Hazardous Waste Site Preliminary Assessment Form

Identification

State | CERCLIS Number

CERCLIS Discovery Date

1. General Site Information

Name | Street Address

City | State | Zip Code | County | Co Code | Cong Dist

Latitude ___ ° ___ ' ___.___ " | Longitude ___ ° ___ ' ___.___ "

Approximate Area of Site
_____ Acres
_____ Square Ft

Status of Site
☐ Active ☐ Not Specified
☐ Inactive ☐ NA (GW plume etc.

2. Owner/Operator Information

Owner	Operator
Street Address	Street Address
City	City
State / Zip Code / Telephone	State / Zip Code / Telephone

Type of Ownership
☐ Private
☐ Federal Agency
Name _____
☐ State
☐ Indian
☐ County
☐ Municipal
☐ Not Specified
☐ Other _____

How Initially Identified
☐ Citizen Complaint
☐ PA Petition
☐ State/Local Program
☐ RCRA/CERCLA Notification
☐ Federal Program
☐ Incidental
☐ Not Specified
☐ Other _____

3. Site Evaluator Information

Name of Evaluator | Agency/Organization | Date Prepared

Street Address | City | State

Name of EPA or State Agency Contact | Street Address

City | State | Telephone

4. Site Disposition (for EPA use only)

Emergency Response/Removal Assessment Recommendation
☐ Yes
☐ No
Date _____

CERCLIS Recommendation
☐ Higher Priority SI
☐ Lower Priority SI
☐ NFRAP
☐ RCRA
☐ Other _____
Date _____

Signature

Name (typed)

Position

EPA Potential Hazardous Waste Site
Preliminary Assessment Form - Page 2 of 4

CERCLIS Number:

5. General Site Characteristics

Predominant Land Uses Within 1 Mile of Site (check all that apply):
- ☐ Industrial
- ☐ Commercial
- ☐ Residential
- ☐ Forest/Fields
- ☐ Agriculture
- ☐ Mining
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility _____
- ☐ Other _____

Site Setting:
- ☐ Urban
- ☐ Suburban
- ☐ Rural

Years of Operation:
Beginning Year _____
Ending Year _____
☐ Unknown

Type of Site Operations (check all that apply):
- ☐ Manufacturing (must check subcategory)
  - ☐ Lumber and Wood Products
  - ☐ Inorganic Chemicals
  - ☐ Plastic and/or Rubber Products
  - ☐ Paints, Varnishes
  - ☐ Industrial Organic Chemicals
  - ☐ Agricultural Chemicals (e.g., pesticides, fertilizers)
  - ☐ Miscellaneous Chemical Products (e.g., adhesives, explosives, ink)
  - ☐ Primary Metals
  - ☐ Metal Coating, Plating, Engraving
  - ☐ Metal Forging, Stamping
  - ☐ Fabricated Structural Metal Products
  - ☐ Electronic Equipment
  - ☐ Other Manufacturing
- ☐ Mining
  - ☐ Metals
  - ☐ Coal
  - ☐ Oil and Gas
  - ☐ Non-metallic Minerals
- ☐ Retail
- ☐ Recycling
- ☐ Junk/Salvage Yard
- ☐ Municipal Landfill
- ☐ Other Landfill
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility _____
- ☐ RCRA
  - ☐ Treatment, Storage, or Disposal
  - ☐ Large Quantity Generator
  - ☐ Small Quantity Generator
  - ☐ Subtitle D
    - ☐ Municipal
    - ☐ Industrial
  - ☐ "Converter"
  - ☐ "Protective Filer"
  - ☐ "Non- or Late Filer"
- ☐ Not Specified
- ☐ Other _____

Waste Generated:
- ☐ Onsite
- ☐ Offsite
- ☐ Onsite and Offsite

Waste Deposition Authorized By:
- ☐ Present Owner
- ☐ Former Owner
- ☐ Present & Former Owner
- ☐ Unauthorized
- ☐ Unknown

Waste Accessible to the Public:
- ☐ Yes
- ☐ No

Distance to Nearest Dwelling, School, or Workplace:
_____ Feet

6. Waste Characteristics Information

Source Type: (check all that apply)	Source Waste Quantity: (include units)	Tier*:
☐ Landfill		
☐ Surface Impoundment		
☐ Drums		
☐ Tanks and Non-Drum Containers		
☐ Chemical Waste Pile		
☐ Scrap Metal or Junk Pile		
☐ Tailings Pile		
☐ Trash Pile (open dump)		
☐ Land Treatment		
☐ Contaminated Ground Water Plume (unidentified source)		
☐ Contaminated Surface Water/Sediment (unidentified source)		
☐ Contaminated Soil		
☐ Other _____		
☐ No Sources		

* C = Constituent, W = Wastestream, V = Volume, A = Area

General Types of Waste (check all that apply)
- ☐ Metals
- ☐ Organics
- ☐ Inorganics
- ☐ Solvents
- ☐ Paints/Pigments
- ☐ Laboratory/Hospital Waste
- ☐ Radioactive Waste
- ☐ Construction/Demolition Waste
- ☐ Pesticides/Herbicides
- ☐ Acids/Bases
- ☐ Oily Waste
- ☐ Municipal Waste
- ☐ Mining Waste
- ☐ Explosives
- ☐ Other _____

Physical State of Waste as Deposited (check all that apply):
- ☐ Solid
- ☐ Sludge
- ☐ Powder
- ☐ Liquid
- ☐ Gas

EPA Potential Hazardous Waste Site
Preliminary Assessment Form - Page 3 of 4

CERCLIS Number

7. Ground Water Pathway

Is Ground Water Used for Drinking Water Within 4 Miles
☐ Yes
☐ No

Type of Drinking Water Wells Within 4 Miles (check all that apply)
☐ Municipal
☐ Private
☐ None

Is There a Suspected Release to Ground Water
☐ Yes
☐ No

Have Primary Target Drinking Water Wells Been Identified
☐ Yes
☐ No
If Yes, Enter Primary Target Population
_____ People

Depth to Shallowest Aquifer
_____ Feet

Karst Terrain/Aquifer Present
☐ Yes
☐ No

Nearest Designated Wellhead Protection Area
☐ Underlies Site
☐ > 0 - 4 Miles
☐ None Within 4 Miles

List Secondary Target Population Served by Ground Water Withdrawn From

0 - ¼ Mile	_____
> ¼ - ½ Mile	_____
> ½ - 1 Mile	_____
> 1 - 2 Miles	_____
> 2 - 3 Miles	_____
> 3 - 4 Miles	_____
Total Within 4 Miles	_____

8. Surface Water Pathway

Type of Surface Water Draining Site and 15 Miles Downstream (check all that apply)
☐ Stream ☐ River ☐ Pond ☐ Lake
☐ Bay ☐ Ocean ☐ Other _____

Shortest Overland Distance From Any Source to Surface Water
_____ Feet
_____ Miles

Is There a Suspected Release to Surface Water
☐ Yes
☐ No

Site is Located in:
☐ Annual - 10 yr Floodplain
☐ > 10 yr - 100 yr Floodplain
☐ > 100 yr - 500 yr Floodplain
☐ > 500 yr Floodplain

Drinking Water Intakes Located Along the Surface Water Migration Path:
☐ Yes
☐ No

Have Primary Target Drinking Water Intakes Been Identified
☐ Yes
☐ No

If Yes Enter Population Served by Primary Target Intakes
_____ People

List All Secondary Target Drinking Water Intakes

Name	Water Body	Flow (cfs)	Population Served

Total within 15 Miles _____

Fisheries Located Along the Surface Water Migration Path
☐ Yes
☐ No

Have Primary Target Fisheries Been Identified
☐ Yes
☐ No

List All Secondary Target Fisheries

Water Body/Fishery Name	Flow (cfs)

EPA Potential Hazardous Waste Site
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CERCLIS Number:

8. Surface Water Pathway (continued)

Wetlands Located Along the Surface Water Migration Path:
☐ Yes
☐ No

Have Primary Target Wetlands Been Identified:
☐ Yes
☐ No

List Secondary Target Wetlands:

Water Body	Flow (cfs)	Frontage Miles

Other Sensitive Environments Located Along the Surface Water Migration Path:
☐ Yes
☐ No

Have Primary Target Sensitive Environments Been Identified:
☐ Yes
☐ No

List Secondary Target Sensitive Environments:

Water Body	Flow (cfs)	Sensitive Environment Type

9. Soil Exposure Pathway

Are People Occupying Residences or Attending School or Daycare on or Within 200 Feet of Areas of Known or Suspected Contamination:
☐ Yes
☐ No

If Yes, Enter Total Resident Population:
_____ People

Number of Workers Onsite:
☐ None
☐ 1 - 100
☐ 101 - 1,000
☐ >1,000

Have Terrestrial Sensitive Environments Been Identified on or Within 200 Feet of Areas of Known or Suspected Contamination:
☐ Yes
☐ No

If Yes, List Each Terrestrial Sensitive Environment:
_____

10. Air Pathway

Is There a Suspected Release to Air:
☐ Yes
☐ No

Enter Total Population on or Within:

Onsite	
0 - ¼ Mile	
> ¼ - ½ Mile	
> ½ - 1 Mile	
> 1 - 2 Miles	
> 2 - 3 Miles	
> 3 - 4 Miles	
Total Within 4 Miles	

Wetlands Located Within 4 Miles of the Site:
☐ Yes
☐ No

Other Sensitive Environments Located Within 4 Miles of the Site:
☐ Yes
☐ No

List All Sensitive Environments Within ½ Mile of the Site:

Distance	Sensitive Environment Type/Wetlands Area (acres)
Onsite	
0 - ¼ Mile	
> ¼ - ½ Mile	

B. FIELD SAMPLING PLAN

B. FIELD SAMPLING PLAN

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B. FIELD SAMPLING PLAN

1.0 PURPOSE, SCOPE AND OBJECTIVES OF SAMPLING

The purpose, scope and objective of this field sampling plan is to collect data in order to determine the source, nature, and extent of contamination on site to support a decision regarding the need for further action. The sample locations will be placed so that the following information can be obtained: the identity of the hazardous substances present, determination of whether hazardous substances are being released to the environment, and whether hazardous substances are impacting specific targets.

As stated previously, limited information obtained from Richards-Gebaur AFB indicates two potential sources for the petroleum contamination found. One source could be a localized spill that occurred in the past when the building was used for motor pool operations. The other source could be from underground pipelines that contained jet fuel in the past that may have leaked. Utility maps of Richards-Gebaur AFB indicate that the abandoned 8-inch POL pipeline appears to intersect underground utility lines (i.e., gas, water, etc.), which would create a potential conduit for the jet fuel to migrate.

In order to determine whether the spill is localized or extends beyond the Fire Valve Area, a field investigation is proposed that involves drilling soil borings and collecting soil samples in the immediate area of the site, and then directing the field sampling effort (with field screening borings) to follow the utility conduits. At this time, the water line adjacent to the Fire Valve Area and possibly, the gas line located across the street from the site are the two utility conduits to be investigated. The sampling effort will probably follow these conduits in a northerly direction, towards the 8-inch POL line. The extent of the investigation will depend on conditions encountered in the field. Soil samples will be analyzed by a field gas chromatograph (GC) to assess volatile organic contamination. The maximum number of field screening boring locations at this time is 30; however, if during the sampling program, conditions warrant additional boring locations, the Air Force POC and COR will be notified and adjustments made per their approvals. A percentage of the soil samples will be collected for laboratory analyses to determine concentrations of compounds (volatile organic compounds, semi-volatile organic compounds, and total petroleum hydrocarbons). The location of the utility conduit will be identified by a magnetometer prior to drilling in order to avoid the pipelines.

If, during field activities, it appears that the contamination is localized and that the interim removal action of 10 cubic yards of soil was adequate, one groundwater monitoring well will be installed and sampled for volatile organic compounds, semi-volatile organic compounds, and total petroleum hydrocarbons to verify that the groundwater was not contaminated from this site. In the event that groundwater contamination is suspected, additional monitoring wells would be

required to delineate the nature and extent of contamination and would be beyond the scope of this PA/SI.

1.1 Site Reconnaissance, Investigation Logistics

The purpose of the reconnaissance is to visually observe the site and its environs and to collect additional information to assist in the PA evaluation. Section A-3.3 of the Work Plan describes the activities to be conducted by Tetra Tech as part of the site visit. Tetra Tech does not foresee the need for an onsite office at this time; however, space will be requested for the storage of sampling equipment and gear during the field activities.

1.2 Surface Geophysical Surveys

The purpose of conducting geophysical surveys of the subsurface at Richards-Gebaur AFB will be to determine the location of subsurface utilities such as pipelines. A portable magnetometer will be used to determine the presence and approximate location of buried pipelines in and adjacent to the areas of concern. The Fire Valve Area is associated with the water supply pipeline, and since non-aqueous phase liquids (petroleum products) were encountered, it is reasonable to expect that the fuel may migrate to some extent along the pipeline. Consequently, the subsurface investigation will be conducted in close proximity to utilities. While there are maps depicting the location of utilities in the subsurface, they are not anticipated to be precise, and magnetometer equipment will be used to more accurately locate the pipelines prior to drilling and sampling.

Magnetometers detect the magnetic fields that set up around objects in the subsurface. By measuring the strength of the field in the subsurface, the approximate location of the buried pipeline can be determined. Pipelines in particular develop strong magnetic fields.

The magnetometer survey will be conducted along areas identified by maps and other sources of information as containing pipelines or other conduits. The survey will be conducted only in those areas where subsurface drilling and sampling is anticipated. The strength of the signal from the magnetometer will be used as the indicator of the location of the pipelines or other conduits in the subsurface. In addition, the approximate depth of the pipeline or conduit can be estimated from the magnetometer measurements.

The purpose of the survey is to locate pipelines and other subsurface conduits in order to avoid damaging them during drilling associated with sampling. If it appears that the contamination appears to move along the backfill in the pipeline trenches, then the survey will also be used to help delineate that area to sample.

1.3 Soil Screening

Soil screening is to be conducted using an HNu PID to grossly screen the auger cuttings and soil the soils as the continuous sampler is opened, and a portable gas chromatograph will be used to screen the soil samples in the field prior to sending samples to the laboratory for chemical analyses. The results of the soil screening with the portable gas chromatograph will be used to assist in the selection of the samples to be sent to the laboratory.

1.3.1 Portable Gas Chromatograph

The portable gas chromatograph (GC) to be used in the field will be a Photovac 10S Plus or equivalent. The gas chromatograph uses a photoionization detector and has a packed wide bore capillary column ideally suited for the C4 - C10 hydrocarbons, chloromethanes, chloroethanes, chloroethylenes, benzene, hydrogen sulfide, DMS, methyl/ethyl mercaptans, and DMDS. The standard photoionization detector lamps used include 8.4eV, 9.5eV, 10.0eV, 10.6eV, or 11.7eV. The GC employs a total VOC detector pre-screen. The Photovac 10S+ has a programmable column oven for closely controlled column temperatures. It also has an on-board computer that performs integrations, tracks system performance, and stores the library of compound calibrations (it can store all of the chromatograms as well).

1.3.2 Applications

The GC is normally used to analyze gas samples by injecting a sample into the GC. Analyzing soil or water samples requires a different approach: the samples are containerized and headspace gas from over the sample is analyzed.

Prior to beginning analysis, it is important to have an understanding of the goal and objectives of the sampling event, and the intended use of the data. The goals for field GC use during this sampling event will be that the analysis are comparable and the application is appropriate. The objectives are to produce field GC data that will allow making informed field decisions and to provide data that can be related to formal analytical results. In addition, the goals and objectives of the sampling event influence GC setup and calibration. Calibration of the GC will involve selecting the appropriate compound standard to use for calibration. For each application in the field, a library of compound calibrations will be created to calibrate the GC to specific compounds at specified concentrations. The library is then used repeatedly for similar applications. Successful calibrations for the range of compounds expected to be encountered helps assume that the application is appropriate.

Sampling event goals and objectives also have a great influence on sample preparation. For example, if screening of soils only for the presence of relatively high concentrations of selected compounds were the objective, then soil sample preparation may not require more than containerizing the soil in any one of a variety of sample containers that would allow sampling

of the head space over the soils. Soil sample containers could be 40 ml vials with septum, tin foil cover jars, or plastic zip-lock bags. However, Tetra Tech's objectives will be to produce data that are comparable and/or will be approximately related to analytical laboratory results; therefore, sample preparation will require a degree of rigor that includes controlling the temperature of the soil sample and container, control of the mass of soil analyzed, and dispersing the soil in a solution.

Sample comparability will involve controlling sample preparation and otherwise controlling variability so that the only variables are a function of the sample itself. Segregating sample types will help in maintaining sample comparability. This is important when comparing data generated from different soil types such as sands, silts, clays, or soils high in organic material such as in near surface soils. Therefore, samples from different soil types will be collected for analyses with the matrix noted.

Data from field screening will be used for a number of decisions. First, the data produced during field screening will be used to select which samples are to be sent to a laboratory and secondly, to assist in selecting the locations of additional soil borings. Reviewing the relative changes in chromatographs in the field will provide a better understanding of contaminant distributions in the soils, which in turn affects decisions for borehole placement.

The data from the field screening will also be used to compare the field GC data to laboratory data. This will be done by collecting a sufficient number of laboratory samples so that regression equations can be developed relating the data sets. The field screening data will be used to predict an equivalent laboratory result greatly expanding the confidence Tetra Tech has in the descriptions of contaminate distributions on the site. The most successful data comparisons are where data from a single soil type are compared to laboratory analysis of soil samples of the same soil type, and where the there is a good distribution of concentrations available. As an example, a silt will respond with different results for equivalent compound concentrations than a sand or clay. The same is true of results from standard analytical procedures. These differences are due primarily to the strength of the absorption of the compound to the soils. Consequently, for purposes of comparisons, separating the field GC and analytical laboratory results by soil type will provide the most useable results for purposes of developing such regression equations.

1.4 Borehole Location, Construction, Lithologic Sampling, and Logging

Soil borings will be drilled to further characterize the site geology/hydrogeology and delineate the nature and extent of contamination. The information obtained during the drilling of the borings will include determining stratigraphic units, depth to water table, and sample depths. A phased approach will be utilized in this field effort. Initially, a total of four soil borings will be drilled to a depth of approximately 15 feet or bedrock (whichever is encountered first). These borings will be located (Figure B-1) around the Fire Valve Area to determine whether contamination exists outside the previous excavation. If contamination is not observed in the

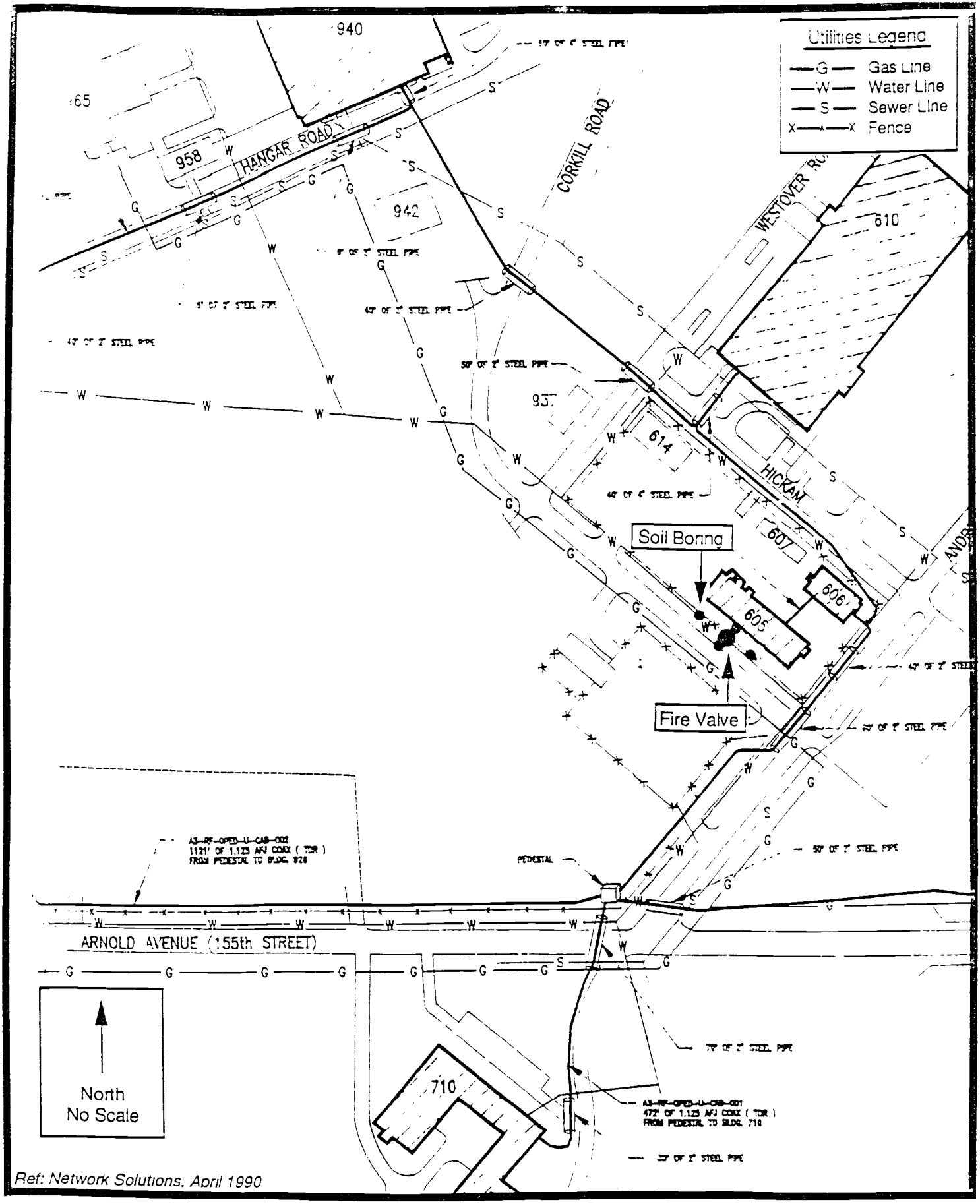

Figure B-1: Approximate Soil Boring Locations for PA/SI at the Fire Valve Area at Richards-Gebaur AFB, Missouri.

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four soil borings, then field screening borings (approximately five) will be drilled within the excavated zone and adjacent to the water lines to depths of approximately 5 to 10 ft. If no contamination is detected, the source of the petroleum contamination would appear to be local and no further soil sampling would occur.

If, however, contamination is detected in any of the soil borings, then additional field screening borings will be drilled to depths of approximately 5 to 10 feet below ground surface at locations along the utility conduits until a total of 30 field screening borings are drilled or petroleum contamination is delineated.

The soil borings will be drilled using a truck mounted, hollow-stem auger drill rig. The auger size will be at least 3-1/4 inches nominal inside diameter (I.D.) and 7-1/4 inches nominal outside diameter (O.D.). During auger advancement, samples will be collected continuously using a five-foot long, continuous tube sampler in cohesive soil, and a two-foot long split barrel sampler in granular soil. The field screening boreholes will be drilled with 4-inch solid flight augers and samples will be taken from the bottom of the flight auger at designated depths. After completion, the boreholes will be grouted with a cement/bentonite grout.

A geologist will supervise the drilling and prepare lithologic logs of the borings using the Unified Soil Classification System. Logging of the field screening boreholes will be from auger cuttings and will not contain as detailed a description of soil conditions encountered. A standard borehole log form will be used to record observations (Figure B-2). The boring log will contain the following information in the designated location:

- Borehole designation
- Borehole location
- Sample depth
- Color of soil sample (Munsell soil color index)
- Unified Soil Classification System designation of soil type and depths of lithologic boundaries
- Stiffness or density
- Moisture content (qualitative)
- Descriptive comments
- Depth at which groundwater is first encountered (if available)
- Variations in drilling rates and rig behavior
- Initials of logger (geologist)
- Drilling Contractor
- Drilling method
- Types of drilling fluids and depths they were used (if applicable)

TETRA TECH BORING LOG

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Boring/Well No.. _____ Page: _____ of _____ Date: _____

Project Name: _____ Project No.: _____

Drill Conrtactor: _____ Drill. Method/Equipment: _____

Start Time: _____ Stop Time: _____ Logged By: _____

Location: _____ Elevation: _____ Water Level: _____

Depth (Feet)	PID Reading	Field GC	Lab Sample	Well Const./ Abandonment	USCS Class.	GEOLOGIC DESCRIPTION [Soil/Rock Classification, Secondary Components (% Sand), Color (Munsel/GSA), Plasticity, Consistency or Density, Moisture Content (Not a %), Texture/Structure, Depositional Environment/Formation]	REMARKS
5							
10							
15							
20							
25							

Figure B-2

All field locations will be marked prior to commencement of drilling activities. Base personnel will be consulted to minimize the disruption of Base activities, to properly position borings with respect to site locations, and to avoid penetrating underground utilities. Permits prior to drilling activities will be obtained from the Richards-Gebaur AFB POC fourteen (14) days before permits are required.

At the completion of borehole drilling, the area of drilling activities will be cleaned and reasonably restored to pre-investigative conditions.

1.5 Monitoring Well Construction and Development

A groundwater monitoring well will be installed to provide data to confirm that the contamination has not extended beyond the Fire Valve Area and original excavation. The location will be determined in the field based on conditions encountered during the soil boring program. To meet plan objectives, standard protocols will be followed during well design, construction, and development.

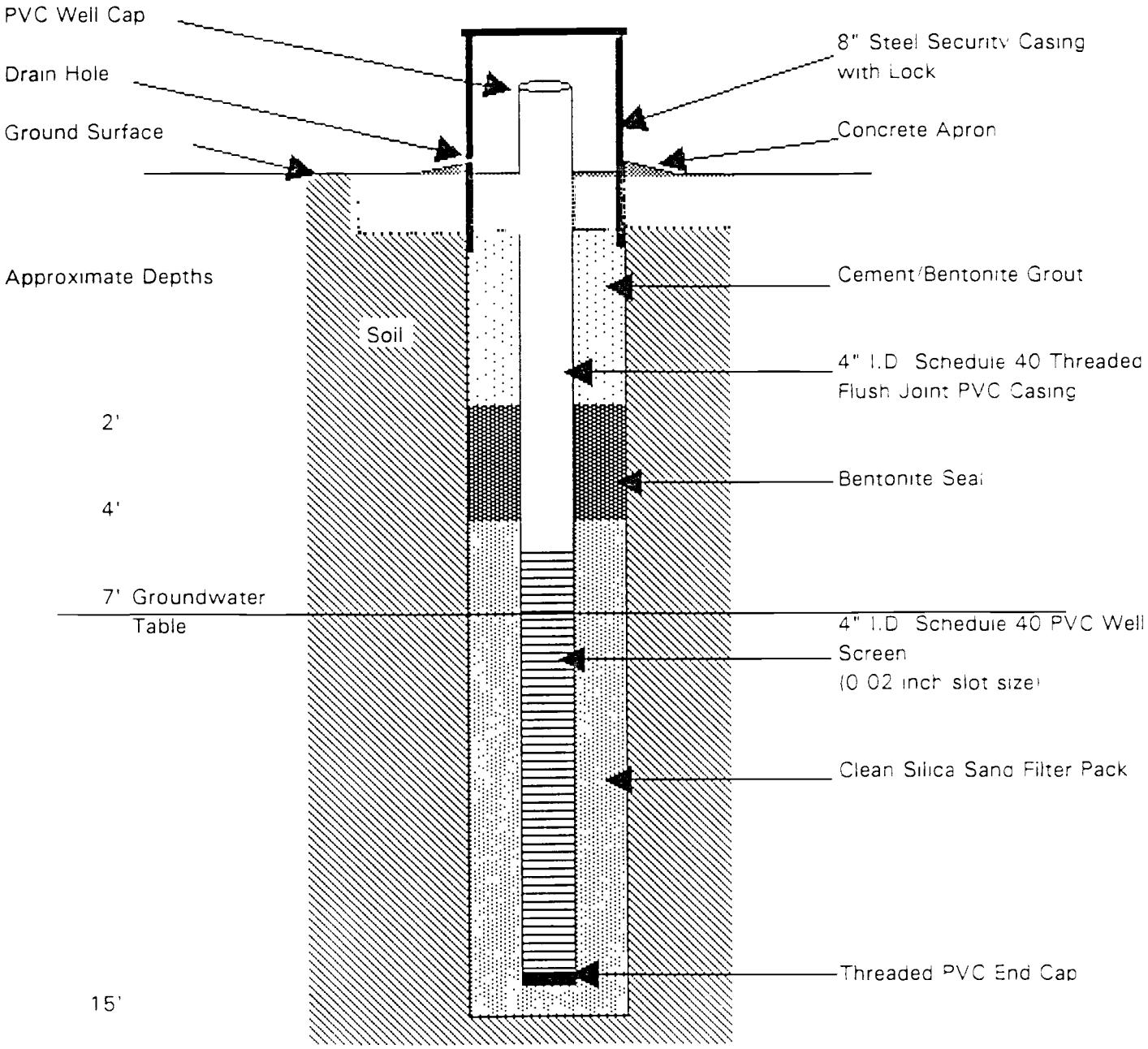
The monitoring well will be drilled using a truck mounted, hollow-stem auger drill rig. During auger advancement, samples will be collected to identify lithology by using a five-foot long continuous tube sampler in cohesive soil, and two-foot long split barrel sampler in granular soil. The total depth of the well is anticipated to be approximately 15 feet or to top of bedrock. A geologist will supervise the drilling and well installation, and will prepare lithologic log (described in the previous section).

The monitoring well will be advanced with hollow-stem augers that are at least 6-1/4 inch nominal I.D. and 10-1/4 inches nominal O.D. A 10-ft long well screen will be installed in the interval from approximately 5 to 15 feet below ground surface. However, placement of the well screen will be dependent on the water table depth. The water table depth in the Fire Valve Area is approximately 7 ft below ground surface. The top of the screened interval will be approximately 2 ft above the water table depth. Allowing 2 ft of screen above the observed water table should be adequate for water table fluctuations. In the geologic environment of this region, water table elevations tend to be highest in the spring, declining somewhat in the summer, rising in the fall, and are generally lowest in winter. Field activities are proposed for November and water table elevations should be at a relatively high level, especially since this region has seen record rainfall events. Figure B-3 illustrates the proposed construction details for the well to be installed at the site.

The well casings and screen will be constructed of 4-inch diameter, Schedule 40, flush-joint threaded PVC. All screens will have factory-milled slots, the size of which will be 0.020 inches (20 slot). The screen will be capped at the bottom with a silt trap and will be set by lowering it through the hollow stem of the auger to the bottom of the boring.

FIGURE B-3

Above-Ground Monitoring Well Completion Diagram



A sand pack of clean, water-washed sand (sized to be compatible with the formation materials and screen slots) will be placed adjacent to the entire screened interval to at least two feet above the top of the screen. All levels of sand will be confirmed by sounding with a weighted tape. The sand pack will be tremied in place in the annulus between the hollow stem and the well casing. The auger will be raised periodically and an auger flight removed to allow the sand to fill the entire annulus between the casing and the borehole wall. The depth of the filter pack will be monitored during installation with a weighted tape. The annular space will be backfilled relatively slowly to allow proper compaction of the material. The volume of filter pack required to fill the annular space (based on the dimensions of the space) will be calculated and the actual amount of filter pack used will be noted. Prior to grouting the well a sufficient period of time will be allowed to pass to ensure that the gravel pack has had adequate time to settle.

A minimum, two-foot vertical layer of bentonite slurry will be pumped through tremie pipe, or poured, into the annular space above the sand pack. The bentonite slurry will be prepared so that it does not infiltrate the filter pack and screen. As the depth to the top of the filter pack is only 4 ft below ground surface, the slurry can be poured into the annular space, as opposed to pumping through a tremie pipe. The seal will be sounded with a weighted tape. The annular space above the bentonite seal will be grouted with a two-component, bentonite-cement grout that is pumped through a tremie pipe, or poured, to ground surface. Again, the seal will be placed from a depth of 2 ft to ground surface where the proper placement of the grout can be observed and noted; therefore, the driller may opt for pouring the grout instead of pumping through a tremie pipe and achieve the same goal of properly sealing the annular space between the borehole and well casing.

The monitoring well will be completed above the ground surface with a locking, protective steel casing extending approximately two feet above the ground surface. A notch will be cut in the top of the casing to be used for a measuring point for water levels. The steel casing will be footed in a cement plug at the top of the hole. The diameter of the steel casing will be at least six inches greater than the diameter of the casing. The concrete pad will be sloped away from the well casing. The identification number of the well will be permanently marked on the well casing cap and on the locking case. After construction of the well, an installation log (Figure B-4) will be completed.

After the concrete and grout have set at least 48 hours, the well will be developed by a combination of surging, bailing, or pumping. The well will be developed until the sediment content of the water is less than 0.75 ml/L as measured in an Imhoff cone according to method E160.5, and the turbidity remains within a ten nephelometric turbidity unit (NTU) range for at least thirty minutes. In addition, the wells will be developed until three consecutive field parameter measurements (each obtained after the removal of one well bore volume) are within 10 percent of one another. The field parameters will include temperature, pH, and specific conductance. The adequacy of well development will be determined by the site geologist. A well development log will be completed to record the field measurements during development (Figure B-5).

FIGURE B-4

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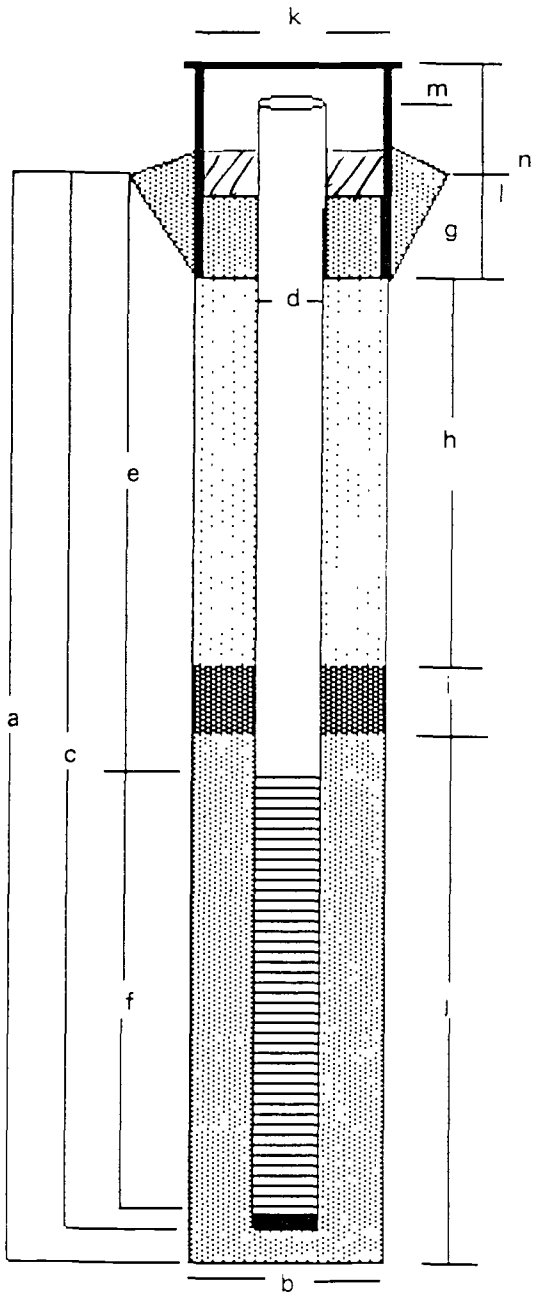
Tetra Tech Monitoring Well Construction Log

Project Name: _____ Well No: _____ Date: _____

Project No: _____ Drilling Method: _____

Geologist: _____



a. Total Boring Depth: _____

b. Boring Diameter: _____

c. Total Casing Length: _____

Casing Type: _____

d. Inner Diameter: _____

e. Depth to Screen: _____

f. Screen Length: _____

Screen Interval: _____

Screen/Slot Type: _____

g. Depth of Surface Grout: _____

h. Depth of Cement Grout: _____

i. Depth to Top of Seal: _____

Type of seal material: _____

j. Depth to Top of Filter Pack: _____

k. Diameter of Protective Casing: _____

l. Length of Protective Casing: _____

Type of Protective Casing: _____

m. Elevation of Casing: _____

n. Surface Elevation: _____

FIGURE B-5 74 57

Sheet ____ of ____

Tetra Tech Well Development Log

Project Name: _____ Project No: _____

Field Personnel: _____ Date: _____

Well No: _____ Casing Size: _____

Date of Installation: _____ Installed Depth of Well: _____

Screened Interval: _____ Screen length: _____

Static Water Level (From Top of Casing)

Before Development: _____ 24 Hrs After Development: _____

Measured Depth to Bottom of Well (From Top of Casing): _____ (Ft.)

Quantity of Water in Well (one well volume) before Development: _____ (Gal.)

Quantity of Water lost during Drilling (if applicable): _____ (Gal.)

Description of Water Quality before Development: _____

Well Development Equipment: _____

_____

Well Volume	Spec. Cond. (umhos/cm)	Temp. (C)	pH	Turbidity	Suspended Sediment*

* Imhoff Cone (selected samples only)

Total Gallons of Water Removed: _____ Well Volumes: _____

Description of Water Quality after Development: _____

1.6 Topographic Survey

Elevation at the top of the monitoring well casing will be established to the nearest 0.01 foot and will be surveyed by a contractor, if required.

The locations of the soil borings and field screening boreholes will be identified in the field using a compass and surveyors tape from a maximum of four appropriate landmarks. The positions will be recorded on site-specific maps.

1.7 Equipment Decontamination

The decontamination procedure used will depend on the location of the sampling operation, the type of equipment being decontaminated, the degree of contamination present on the equipment, and the intended use of the equipment. The equipment will be allowed to air dry prior to use. Where possible, decontamination will be carried out at the sampling site and the fluids will be discharged into the area the equipment was used.

Drilling, sampling, and monitoring well installation equipment will be decontaminated as follows:

- Drill rig augers, drill rods, continuous sampler, and drill bits will be cleaned with high pressure hot water prior to use and between borings, as necessary, at the decontamination area identified by the Base POC. Visible soil and grease will be removed at this time.

- Casing, screen couplings, and caps used in monitoring well installation will be steam-cleaned or pressure-washed prior to installation. Visible foreign matter will be removed at this time.

- Bailers (non-disposable), stainless steel sampling spoons, and split spoons will be initially washed in TSP solution, rinsed with tap water, and rinsed with distilled water prior to each use. Rope or string used with bailers will be replaced after each sampling event. Bailer ropes will be protected from contact with the ground and contaminated equipment.

- Steel tapes, well sounders, transducers, and water quality probes will be rinsed in deionized water, or cleaned in a TSP solution and rinsed once with clean water after each use. Generally, only the wetted end of these devices will require cleaning, provided it is washed and rinsed prior to being reeled onto the takeup spool.

- o Water and soil sample containers will be prepared by the analytical laboratory according to U.S. EPA procedures.

1.8 Waste Handling and Disposal

All used non-hazardous, disposable equipment will be bagged, sealed, and containerized for proper offsite disposal. All drill cuttings and drilling fluids will also be containerized for off site disposal. All containerized material will be sampled, if suspected to be hazardous, in accordance with state and federal requirements for waste characterization prior to disposal. The containers will be transported to a temporary storage area on the Base and designated by the Richards-Gebaur AFB POC. All hazardous waste will be transported to a licensed RCRA approved facility before 30 days of storage transpires and be accompanied by a Uniform Hazardous Waste Manifest. A final copy of the manifest will be provided to the AFB POC. Notification of the need for manifest document signature will be given to the Base POC 48 hours prior to transport of the hazardous waste and the name of the RCRA-approved facility.

1.9 Field Activities Summary

A total of one monitoring well and four soil borings are planned at this time. The number of field screening borings are 30 maximum but the actual number will be based on conditions encountered in the field. The location of the four soil borings are shown on Figure B-1. The locations of the field screening borings and monitoring well will depend on conditions encountered during the field activities.

2.0 ENVIRONMENTAL SAMPLING PROCEDURES

This section describes the proposed subsurface soil, NAPL, field GC sampling, and groundwater sampling procedures to be followed while conducting the field investigation.

2.1 Subsurface Soil Sampling

Soil samples will be obtained for chemical analyses from the soil borings. After the five-foot continuous sampler is withdrawn from the hollow stem auger and opened, the soil core will be screened with the PID. The readings obtained with the PID will be recorded (on the boring log), and the soil core will then be logged by the geologist. Upon completion of logging the soil core, decisions will be made about which intervals to sample for soils analyses based on the judgement of the field geologist (as described in Section B-2.3). The size of the interval to be sampled will allow for a replicate soil sample when appropriate. Three sample containers will be used for each sample interval: one jar will be for VOCs, one for semi-volatile organic compounds, and one for TPH. Approximately three to six inches of soil core will be collected for the sample. Soil samples will be placed in appropriate sample containers specified in the QAPP.

The soil core selected for sampling will be split vertically into four quarters and three of the sections will be divided and used to fill sample jars. This procedure greatly reduces volatile losses from the samples, as well as reduces sample bias that can result from the subsampling of mixed samples. Blended samples tend to segregate according to particle size and density in a mixing bowl such that the soils in the bowl may not be uniformly mixed. By using the above procedure, the same soil intervals are uniformly distributed into each sample jar. In addition, lithologic descriptions and multiple analyses from the same sample intervals can be obtained.

2.2 Non-Aqueous Phase Liquid Sampling

If encountered, non-aqueous phase liquids (NAPLs) will be sampled to allow determination of the type of NAPL present, also known as fingerprinting (i.e., jet fuel, diesel). Based on available information, it is likely that if NAPLs are encountered that they will be light or LNAPLs with a specific gravity less than 1.0. Consequently, the LNAPLs are anticipated to be encountered at or near the water table surface. LNAPLs can be found above or below the watertable held in a state of residual saturation. LNAPLs that are encountered on the water table surface during the drilling of soil borings will be sampled using a disposable bailer, or equivalent. The sample will be transferred from the bailer to 40 ml vials. Prior to tightening the lid of the vial, the sample will be allowed to equilibrate to the temperature that the sample will be stored and shipped. Hydrocarbons can expand or contract greatly with changing temperature, resulting in leaking sample containers unless sample temperatures are kept relatively constant. Sample containers will be placed in paint cans filled with an absorbent material and sent to the appropriate laboratory for analyses.

2.3 Sampling of Soils for Field Screening with Portable Gas Chromatograph

Soils will be screened for VOCs in the field using a portable gas chromatograph. Based on the results of the screening, samples will be selected for laboratory analyses. Soils screened with the portable GC in the field will be selected largely based on judgement by the project geologist. A number of factors affect the judgement to screen a particular soil strata. Each five-foot soil core will be screened using the PID immediately after the continuous sampler is opened. The PID screening guides the sampler in deciding which portion of the soil core to collect for samples. Other factors include the lithologic character of the soils, abnormal staining or coloration of soils, and soil structure. It is also common to sample several intervals within a borehole to help determine how contamination is spread vertically. All of these factors influence the judgement of the sampler when selecting samples for field screening with the portable GC.

Since there is the potential that any sample collected for screening with the portable GC will be sent to the analytical laboratory, three sample containers will to be collected for each sample. One jar will be collected for TPH analysis, one for semi-volatile organic compound analysis.

and one for volatile organic compound analysis. A 10 gram sample will be collected from the TPH or semi-volatile sample jars for analysis by the portable GC.

The standard approach that will be used to prepare soil samples for analysis with the Photovac 10S+ will involve placing 20 ml of solution into the 40 ml vial that contains 10 grams of soil. The solution will be either distilled water, or 40 grams of sodium hexametaphosphate dissolved in one liter of distilled water, with a sodium carbonate buffer. The sodium hexametaphosphate disperses silts and clays, while the sodium carbonate buffers the solution to between pH 8.0 to pH 9.0. Where silts and clays are present in the soil samples, breaking up the clay peds through dispersion is important in maintaining comparability of samples.

The vial containing the soil and solution will be shaken vigorously to speed up the full dispersion of silts and clays in the soil. After the solution and soil sample have had an opportunity to equilibrate, a sample of the atmosphere over the soil slurry is withdrawn and injected into the GC for analysis.

The Photovac 10S+ will be equipped with a prescreening total VOC detector which allows the samples to be prescreened for total VOC concentrations. If the concentrations are very high, the sample can by-pass the GC column and a second, smaller gas sample can be injected into the GC for analysis. The prescreening of samples is useful as very high VOC concentrations frequently result in carryover of the organics to the next sample, necessitating purging the column prior to running additional analysis. The chromatogram of the each analysis is printed out in the field, as well as being stored on disk for subsequent use.

Once the samples have been screened with the field GC and samples have been selected for analysis by the analytical laboratory, the remainder of the samples will be containerized with the cuttings from the soil borings. The results of the field GC will be recorded on a log sheet (Figure B-6) that contains information concerning sample matrix, volume, results, etc.

2.4 Groundwater Sampling

One groundwater sampling event is anticipated after the installation of the monitoring well. The groundwater sample will not be collected within 24 hours of monitoring well development. Sampling will be conducted using either dedicated PVC or disposable Teflon bailers, as described in the following procedures.

1. Measure groundwater surface elevation and well depth with an electronic water level indicator to $\pm$ .01 feet to calculate the well bore storage volume. The well bore volume is defined as the volume of submerged casing, screen, and filter pack.

FIGURE B-6

TETRA TECH PORTABLE GAS CHROMATOGRAPH LOG SHEET

Project Name: _____ Operator: _____

Project No.: _____ Calibration: _____

Date Analyzed	Sample Number	Source Matrix	Weight/ Volume	Sample Preparation	Sample Size	Results in ppm/ppb (circle)							Remarks
						Benz	Tol	EB	Xyl	TCE	VC	Totals*	
8/8/93	SB-10-12'	Soil	10 g	Air	10 ul	10	5	0	5	10	5	150	Ship to Lab

* Total area under curve; includes unidentified compounds.

Sample Preparation: A = Air CS = Sodium Hexametaphosphate Solution DI = Distilled Water

[ ] Shading indicates an example of the type of information to be provided on the form.

2. Remove at least three well bore volumes from the well using a decontaminated, positive displacement pump, dedicated or disposable bailer, or submersible pump, placing the purged water in a graduated container to determine purged volume. Continue purging until two consecutive readings of temperature, pH, turbidity, and specific or electrical conductance (EC) are obtained that are within the following units of measure: temperature $\pm$ 1 deg. C, pH $\pm$ 0.1 units, and EC $\pm$ 5%. If these parameters do not stabilize, the sample will be taken after 6 well bore volumes have been removed. The total volume removed will be recorded. Each measurement will be obtained after the removal of one well bore volume.

3. Rinse a clean beaker with well water prior to filling for field measurements. Measure temperature, pH, turbidity, and specific conductance of the purge sample in the beaker. Record measurements in the field logbook.

4. If the well yields insufficient water to purge three well bore volumes, evacuate the well to dryness once; if the water is still turbid after recovery, purge again, then sample as soon as the well recovers sufficiently. The well will be sampled within 16 hours after purging or after the water level has recovered to 80 percent of its static level, whichever occurs first.

6. Lower the bailer slowly until it contacts the water surface. Allow the bailer to sink with a minimum of disturbance to a point midway between the well bottom and the water surface. Raise the bailer slowly to the surface after filling it with groundwater.

7. Samples will be collected for volatile organic compounds first. These samples will be immediately sealed in a container so that no headspace exists. In addition, these samples will not be composited, homogenized, or filtered.

8. Label the sample containers with all necessary information. Collect and containerize groundwater samples, and add appropriate preservatives to samples as specified in the Quality Assurance Project Plan (QAPP).

9. Rinse the exterior of the filled, sealed sample containers with tap water and dry with a paper towel. Record the sample information in the field logbook and complete all chain-of-custody documents and seals. Seal each sample container in a resealable bag, if possible, to reduce the possibility of contaminating other samples if a sample container leaks or breaks.

10. Place the properly labeled and sealed sample containers in a cooler with ice and maintain at 4° C for the duration of the sampling and transportation period. Do not allow samples to freeze.

2.5 Sample Analyses

The current scope of the analyses will be to provide data to define the nature and extent of contamination of the site. The soil samples will be analyzed for volatile organic compounds (Method SW 5030/8240), semi-volatile organic compounds (Method SW 3550/8270), and total petroleum hydrocarbons purgeable (Method SW 5030/8015) and extractable (Method SW 3510/3520/8015). Quality Assurance/Quality Control (QA/QC) procedures for the analyses of these samples is described in the following Section C. The groundwater samples will also be analyzed for volatile organic compounds (Method SW 5030/8240), semi-volatile organic compounds (Method SW 3510/8270), and total petroleum hydrocarbons purgeable (Method SW 5030/8015) and extractable (Method SW 3510/3520/8015). In addition, a waste characterization sample of the drill cuttings will be collected for TCLP metals, VOCs, and semi-volatile organic compounds (Methods given on Table B-1). A summary of the soil and groundwater samples to be taken and analyzed is shown on Table B-1. The estimated number of soil and groundwater samples to be collected per sample location is shown on Table B-2. The actual locations of the borings and the monitoring well will be determined in the field and are dependent on the extent of contamination found during the investigation.

2.6 Sample Handling, Custody, and QC Samples

All samples (soil and groundwater) collected during the field sampling program will be clearly labeled with the following data immediately upon collection:

- o Project name and number
- o Date and time of collection
- o Sample number
- o Analysis(es) requested.

The above information, with the addition of the following, will be recorded in the field log book by the sampling personnel at the time of the groundwater sample collection:

- o Sampler's name
- o Field measurements and values obtained
- o Visual turbidity of the sample.

As each sample is collected and labeled, it will be packaged appropriately to prevent breakage and placed in the shipment container for delivery to the laboratory. A chain-of-custody form (figure provided in Section C-QAPP) will be completed by the field personnel and will accompany the samples to the laboratory. At a minimum, the chain-of-custody form will include:

Table B-1: Projected Summary of Soil and Water Samples for the Fire Valve Area, Richards-Gebaur AFB.

Matrix	Parameter	Analytical Method	Reporting Units	Fire Valve Area	Trip Blanks(a)	Ambient Condition Blanks	Equipment Blanks(b)	Duplicate/ Replicate Samples(c)	Second Column	Total Analyses
Soil										
	TPH-Purgeable	SW 5030/ 8015	mg/kg	30			3	3		36
	TPH-Extractable	SW3510/ 3520/8015								
	VOCs	SW5030/ SW8240	mg/kg	30	3		3	3		39
	Semi-VOCs	SW3550/ SW8270	mg/kg	30			3	3		36
Water										
	TPH-Purgeable	SW 5030/ 8015	mg/l	1				1		2
	TPH-Extractable	SW3510/ 3520/8015								
	VOCs	SW5030/ SW8240	ug/l	1	1			1		3
	Semi-VOCs	SW3510/ 8270	ug/l	1				1		2
Waste Characterization										
	TCLP Metals	SW1311/ SW6010	mg/l	1						1
	TCLP Mercury	SW1311/ SW7470	mg/l	1						1
	TCLP VOCs	SW1311/ 8240	mg/l	1						1
	TCLP Semi-VOC	SW1311/ 8270	mg/l	1						1

Note:
The number of soil samples collected for chemical analyses are estimated and may change based in field conditions encountered.
(a) One trip blank is to accompany every shipment or cooler. Assume 3 shipments of samples to laboratory.
(b) One equipment blank is to be taken each day of sampling. Assume 3 days of sampling.
(c) 10% of all soil samples are to be field replicates. 10% of all water samples are to be field duplicates.

TPH = Total Petroleum Hydrocarbons, VOCs = Volatile Organic Compounds, TCLP = Toxicity Characteristic Leaching Procedure

Table B-2: Projected Summary of Samples for the Fire Valve Area, Richards-Gebaur AFB.

Location	Number of Samples for Chemical Analyses per Sample Location (a)	Parameters
Soil Borings		
SB-1	2	TPH, VOCs, Semi-volatile Organic Compounds
SB-2	2	TPH, VOCs, Semi-volatile Organic Compounds
SB-3	2	TPH, VOCs, Semi-volatile Organic Compounds
SB-4	2	TPH, VOCs, Semi-volatile Organic Compounds
Field Screening Borings(b)		
FSB-1	1	TPH, VOCs, Semi-volatile Organic Compounds
FSB-2	1	TPH, VOCs, Semi-volatile Organic Compounds
FSB-3	1	TPH, VOCs, Semi-volatile Organic Compounds
FSB-4	1	TPH, VOCs, Semi-volatile Organic Compounds
FSB-5	1	TPH, VOCs, Semi-volatile Organic Compounds
Groundwater		
MW-1	1	TPH, VOCs, Semi-volatile Organic Compounds

Note:
Table does not include QA/QC samples.
Sample depths will be determined in the field.
Actual soil boring, field screening borings, and monitoring well locations will be determined in the field.

(a) Estimated number of samples per boring; number is subject to change .
(b) The number of Field Screening Borings (FSB) may increase to a maximum of thirty, based on the extent of contamination detected in the field.

TPH = Total Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds

- o Project name and number
- o Sampler's name and signature
- o Date of sample collection
- o Sample number
- o Analytical parameter(s).

This information and the number of QC samples is found in greater detail in Section C of this report.

3.0 FIELD MEASUREMENTS

Field data will be collected during various stages of the soil and groundwater investigation. This section describes routine procedures that personnel will follow while performing field measurements. The methods presented below are intended to ensure that field measurements are consistent and reproducible when performed by individuals on the field investigation team. In addition, the manufacturer's instruction manuals for each instrument used will be available on site for use by field personnel.

3.1 Water Temperature

Field Procedure

1. Carry two thermometers, in cases, into the field.
2. Check thermometer for cracks or gaps in the mercury.
3. Draw sample of at least 200 ml into beaker or sample bottle.
4. Place thermometer in sample. Do not allow thermometer bulb to touch sides of beaker and allow to equilibrate (about 1 min).
5. Record temperature to nearest 1° C in the field logbook or on a field data sheet.
6. Duplicate measurements will be taken at a frequency of one in ten samples and will be used to estimate the precision of the field temperature measurements.

Instrument Calibration

The instrument will be calibrated monthly using a National Bureau of Standards certified thermometer.

3.2 pH for Groundwater

Field Procedure

1. Rinse 500-ml plastic beaker with small portions of sample water three times.

2. Rinse electrode with sample water.

3. Immerse electrodes in sample while swirling the sample, if needed, to provide thorough mixing. Turn on meter and read pH to nearest 0.1 unit once the reading is stabilized.

4. Record sample pH. Note any problems such as drift of meter readings.

5. Duplicate measurements will be taken at a frequency of one in ten samples and will be used to estimate the precision of the field pH measurements.

Instrument Calibration

1. Calibrate pH meter according to manufacturer's instructions in the field laboratory at the beginning of any day of field work or field laboratory work when pH will be measured, then recalibrate each time pH meter is moved (e.g., station to station), or at a minimum of every 10 samples analyzed

Maintenance

1. Check batteries each time meter is used. Carry a spare battery pack and a screwdriver into the field in the pH meter case.

3.3 Specific Conductance

Field Procedure

1. Zero and span the instrument according to the manufacturer's instructions.

2. Collect water sample in 500-ml plastic beaker.

3. Swirl conductivity probe in sample: discard sample.

4. Collect fresh sample in beaker.

5. Measure sample temperature to nearest 1° C with the instrument, if possible, or a thermometer. Record temperature.

6. Immerse conductivity probe in sample. Move probe around in sample to displace any air bubbles.

7. Select the lowest appropriate multiplier setting to obtain the greatest meter needle deflection. Read the conductivity from the dial and record in field notebook.

8. Duplicate measurements will be taken at a frequency of one in ten samples and will be used to estimate the precision of the field-specific conductance measurements.

Instrument Calibration

At the beginning and end of each day of sampling, determine the cell constant in the field laboratory.

1. Rinse probe with one portion of the standard Kcl solution.

2. Measure the conductivity of another portion of the standard Kcl solution.

3. Measure temperature of the standard Kcl solution.

4. Calculate the cell constant. The cell constant is the ratio of the known conductivity to the measured conductivity of the standard Kcl solution. Use this constant and measured field temperatures and conductivities to calculate conductivity at 25° C for each sample taken during the day.

Maintenance

1. Store the meter in the field laboratory with the probe immersed in deionized water.

2. Check batteries each morning before taking meter into the field. Carry spare alkaline batteries and screwdriver.

3. Inspect conductivity electrodes on a monthly basis for loss of platinum black.

4. Clean and replatinize probe according to the manufacturer's instructions whenever platinum black has flaked off, a sharp endpoint cannot be achieved, or readings are erratic.

3.4 Turbidity Meter

Field Procedure

1. Turn the instrument off and check the mechanical zero setting, adjust as necessary.

2. Turn the instrument on and check the battery.

3. Place the focusing template into the cell holder and zero the instrument according to the manufacturer's instructions.

4. Remove the focusing template and place the appropriate Gelex secondary standard for the turbidity range to be used into the cell holder. Place the light shield over the turbidity standard and allow the meter to stabilize.

5. Adjust the span control for a meter reading equal to the value of the Gelex standard. Remove the light shield and turbidity standard.

6. Select the range that will exceed the expected turbidity of the sample.

7. Fill a clean sample cell to the white line with the sample to be measured and place it into the cell holder. Use the white dot on the sample cell to orient the cell in the same position each time. Cover the sample cell with the light shield and allow the meter to stabilize. Read and record the turbidity of the sample.

8. Duplicate measurements of turbidity will be taken at a frequency of on in ten samples and will be used to estimate the precision of the field measurements.

Instrument Calibration

Calibration of this instrument is based on Formazin, a polymer whose light-scattering properties can be reproduced accurately and precisely. At the beginning of each day of use, calibrate this instrument.

1. With the instrument turned off, check the mechanical zero adjustment and adjust as necessary.

2. Turn the instrument on and perform a battery check.

3. Place the focusing template into the cell holder, press the 1.0 range switch, and adjust the zero to obtain a zero NTU reading.

4. Remove the focusing template and insert a 0.75-NTU turbidity standard, then adjust the span control for a corrected 0.75-NTU reading.

5. Remove the 0.75-NTU standard and replace it with a 10-NTU standard. Press the 10 range switch. The meter should indicate 10 (± 0.2) NTU. If it does not, the 10 range potentiometer needs adjustment (refer to the manual for instructions). Adjust the span to read exactly 10 NTU.

6. Remove the 10-NTU standard and replace it with the cell riser and 100-NTU standard. Press the 100 range switch. The meter should indicate 100 (± 2) NTU. If it does not, the 100 range potentiometer needs adjustment (refer to the manual for instructions).

7. Remove the 100-NTU standard and cell riser and insert the 10-NTU standard. Press the 10-NTU range switch. Adjust the span to read 10 NTU.

8. Remove the 10-NTU standard and replace it with the 0.75-NTU standard. Press the 1.0 range switch. The meter should indicate the corrected value for the 0.75-NTU standard (± 0.02) NTU. If it does not, the 1.0 range potentiometer needs adjustment (refer to the manual for instructions).

Maintenance

1. The battery pack life is approximately 10 hours per charge and can be recharged more than 300 times. The battery pack should be charged the night before the instrument is used. The battery pack will reach full charge in 12 to 16 hours.

2. The lamp image is focused at the factory with the aid of the focusing template furnished with the instrument. Inside the template are two plastic discs that define the target circle. When the template is placed in the cell holder assembly, the properly focused instrument will show the image of the lamp within the target circle. If the image is not centered, or is too small or too large, readjust according to the manual.

3. Other than the sample cells themselves, the only optical surfaces that require occasional cleaning are those of the lens, located in the bottom of the cell holder assembly. Remove the lens as described in the manual. Use a cloth or tissue to clean the lens surface.

3.5 Portable Gas Chromatograph Calibration

The following method for calibrating the Photovac 10S+, or equivalent machine, will be performed in the field. At the start of operations, the following procedures will be performed: 1) prepare a set of standard solutions of compounds in water; 2) collect a known volume of gas from the headspace over the standard; and 3) inject the gas into the GC. The GC's computer will read the resulting peak and time of occurrence as belonging the specific compound and concentration. This process is repeated for up to twenty-five compounds, which are stored in a library within the computer on disk and on an application card. This method provides relative concentrations that are more relevant or comparable to results obtained from analytical laboratories. In order to check or confirm that the machine is functioning properly, the machine will also be calibrated or checked with a manufacturer's prepared gas sample. This involves injecting a known quantity of gas with a known compound concentration into the GC and the GC computer accepts the resulting peak and time of occurrence as being associated with the entered compound and concentration. The calibration check with a commercially available, prepared gas sample will be conducted at the start and finish of each day that the instrument is used.

The preparation of the standards will be performed at the start of operations. Commercially prepared standards will be diluted to prepare a standard of lesser concentration. Consequently, if a standard consisting of 1 mg/l of benzene were to be prepared from a standard containing 1000 mg/l benzene, 1 ml of the 1000 mg/l standard would be mixed with 999 ml of water. The diluted standard would then contain 1 mg/l benzene. The standards are used by placing 20 ml of the standard in a 40 ml vial with a septa in the cap. The vial is shaken and given several minutes for the benzene to equilibrate concentrations between the atmosphere over the water and in the water. A predetermined volume of the atmosphere over the sample (typically 5 ul) is withdrawn with a syringe and injected into the GC. Subsequent sample analysis will consist of a equivalent gas volume.

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PRELIMINARY ASSESSMENT/SITE INVESTIGATION
of
IRP SITE SSOO9, FIRE VALVE AREA
for
RICHARDS-GEBAUR AIR FORCE BASE, MO

Approval: Russell B. Krohn — 11/17/93

Russell B. Krohn
Tetra Tech, Inc.
Project Manager

Date

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Pamela L. McKee
Tetra Tech, Inc.
Project Health and Safety Manager

Date

1.0 INTRODUCTION

This site-specific Health and Safety Plan establishes policies and procedures to protect all site personnel from the potential hazards posed when performing investigative/sampling activities at the Richards-Gebaur AFB. The site safety plan also provides measures to minimize potential exposure, accidents, and physical injuries that may occur when conducting onsite activities. This plan has been developed utilizing information obtained during the site visits, previous investigations, and from information obtained during the file review. This plan may be amended, as necessary, to address actual site conditions encountered by site workers.

This plan must be observed by all Tetra Tech employees. Medical surveillance, personal protection, respirator fit test, and hazardous waste operations training requirements as described in the appropriate Occupational Safety and Health Administration regulations (OSHA - 29 CFR 1910.120), will be met by all personnel working in the control zone at this site. All observers present during these activities must also comply with the safety requirements of this plan. To ensure safety compliance, all site personnel must read this plan and sign a Consent Agreement (Appendix D-1) stating that they agree to comply with all the plan conditions before they are allowed on site or to participate in the sampling/investigative activities.

The contents of this Health & Safety Plan were developed by Tetra Tech with the intent to conform to U.S. Department of Labor requirements [Occupational Safety and Health Act (OSHA)]; U.S. Air Force and other applicable federal laws. Where any of these are in conflict, the more stringent requirements will be followed and enforced. Work conditions can be expected to change as the investigation progresses. As appropriate, written addenda to the general plan will be provided by the Project Health and Safety Manager (PHSM) and approved by the regional Certified Industrial Hygienist (CIH). No changes to the plan will be implemented without prior approval of the PHSM.

A copy of the Health & Safety Plan will be kept on the site for the duration of the investigative/sampling activities. Changes to the plan will be noted, dated, and initialled by the Site Health and Safety Officer (SHSO) after approval is received from the PHSM.

1.1 Background

On July 8, 1993, Tetra Tech, Inc. was tasked by the Air Force Center for Environmental Excellence (AFCEE) under Contract No. F33615-90-D-4006, Delivery Order 0008, to perform a PA/SI of the Fire Valve Area, IRP Site SS009 on Richards-Gebaur AFB.

The Fire Valve Area is located at the edge of the Civil Engineering Complex, directly behind (south side) Building 605. During excavation by an Air Force contractor in March 1992 to repair an underground water main valve, petroleum product was discovered. The trench soils were tested and contaminant levels exceeded the State of Missouri's cleanup action levels for

Benzene/Toluene/Ethylbenzene/Xylene (BTEX) and Total Petroleum Hydrocarbons (TPH). The source of the petroleum discovered in the trench has not been determined. Approximately 10 cubic yards of soil was removed and the excavation was backfilled with clean fill.

1.2 Proposed Activities

The purpose of this PA/SI is to determine the source of the petroleum contamination detected in the Fire Valve Area, Site SS009, define the nature and extent of potential contamination in the soil and groundwater, and identify potential threats to human health and the environment in relation to this site. The PA/SI will include the collection of soil samples from soil borings drilled in areas adjacent to the Fire Valve Area and possibly along the utility corridor. In addition, one groundwater monitoring well may be installed, depending on conditions encountered in the field. A groundwater sample would be collected from that well.

1.3 Conceptual Site Model

The conceptual site model is to be used for identifying migration routes and potential receptors, by integrating geologic and hydrologic information, and providing the basis for a human health and ecological risk assessment. The conceptual site model is developed after a review of all available site information during the PA, and is then refined or revised with the inclusion of additional site data, whenever appropriate, throughout study. Based on the current information available, Table A-2 presented in Section A - Work Plan, presents Tetra Tech's understanding of current site conditions as related to migration pathways and exposed population. The model will be revised after the completion of the PA/SI tasks. In addition, after field activities are conducted and more information is gained regarding the source of the contamination, a figure will be prepared indicating the exposure scenario most representative of the Fire Valve Area.

1.4 Organization

All personnel are responsible for continuous adherence to the safety procedures outlined in the Health and Safety Plan during the performance of any work. In no case may work be performed in a manner that conflicts with the intent of or the inherent safety and environmental cautions expressed in these procedures. After due warnings, personnel who violate safety procedures will be dismissed from the site and potentially terminated. All field personnel shall be properly trained in health and safety regulations associated with handling hazardous materials and the safe operation of equipment. All onsite personnel will be trained as necessary to the specifications set forth by Title 29 Code of Federal Regulations Part 1910.120 (29 CFR 1910.120), and this document. Figure D-1 illustrates the organization of the health and safety program, and the following section describes the responsibilities of those shown.

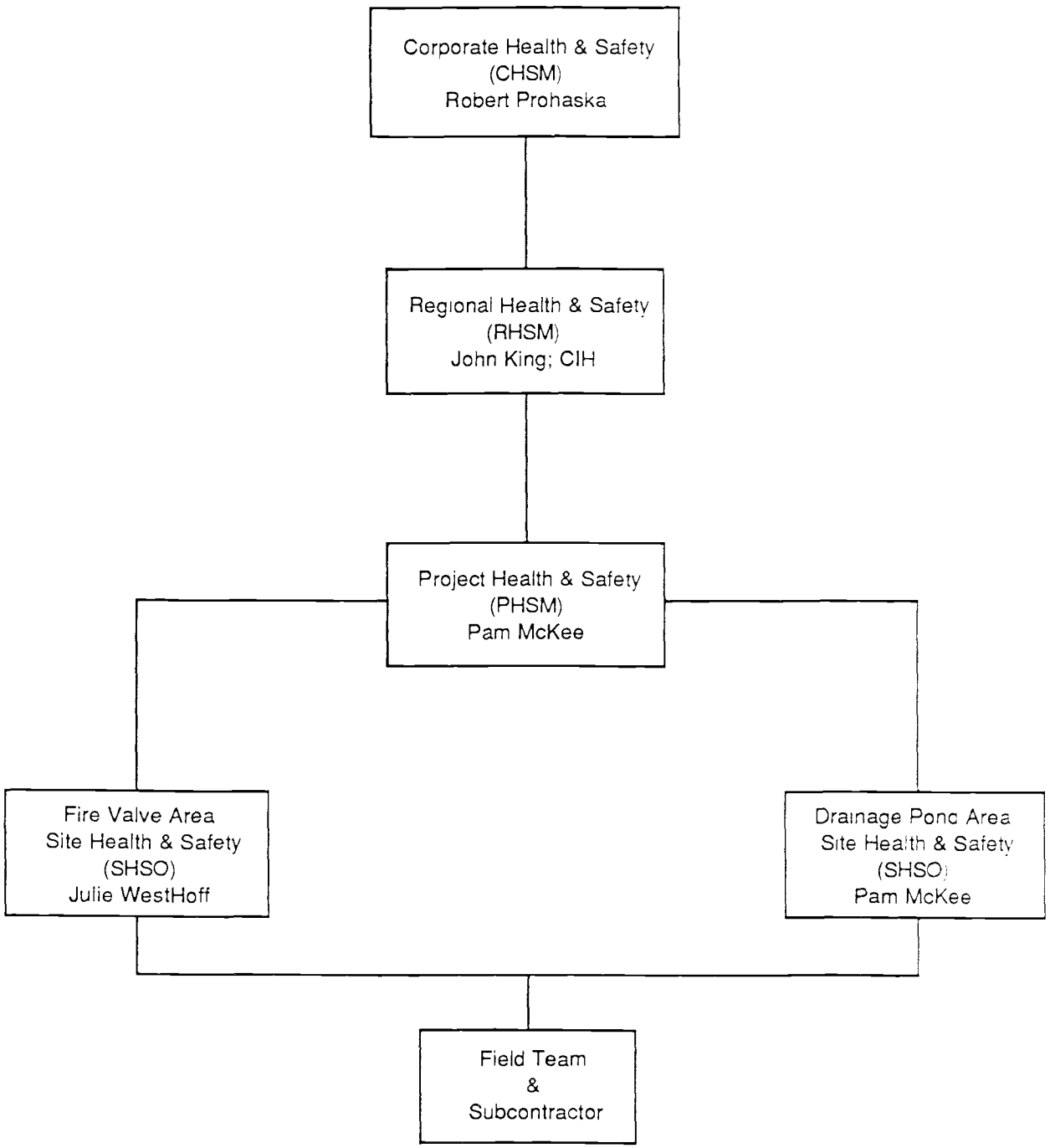


FIGURE D-1
ORGANIZATION OF HEALTH & SAFETY PROGRAM
FOR THE RICHARDS-GEBAUR AFB, MISSOURI

Regional Certified Industrial Hygienist

The Regional, Certified Industrial Hygienist (CIH), Mr. John King, is responsible for coordinating the Health & Safety Plan and addenda specific to the site. He is responsible for ensuring that this Health & Safety Plan complies with 29 CFR 1910.120 and any other applicable regulations including medical surveillance, training requirements, hazard assessment, personal protective equipment, field implementation, air monitoring protocols, decontamination products, hazard communication, contingency planning, and field audits. The CIH will approve any updates or changes to this Health & Safety Plan, if warranted by site conditions. Additional responsibilities include:

- Assisting in corporate investigations related to reports of non-compliance with the Health & Safety Plan
- Coordinating corporate investigations regarding injuries incurred during project operations
- Auditing/inspecting sites to determine effectiveness of the site Health & Safety Plan, and to immediately correct any deficiencies noted.

Project Health and Safety Manager

The Project Health and Safety Manager (PHSM), Ms. Pam McKee, is responsible for developing and coordinating the Health & Safety Plan and addenda specific to the site. This plan complies with 29 CFR 1910.120 and other applicable regulations, in all respects, and includes medical surveillance, training requirements, hazard assessment, personal protective equipment, field implementation, air monitoring protocols, decontamination procedures, hazard communication, contingency planning, and field audits. The PHSM will update and change plans, if warranted by site conditions, and shall have the only authorization to effect such changes. In addition, the PHSM will be responsible for ensuring that all task managers implement the requirements set forth in this plan. Agency liaison on matters relating to safety and health will also be the responsibility of the PHSM. Additional responsibilities include:

- Updating standard equipment and procedures based on new information obtained during site operations
- Ensuring that all project personnel have received necessary training and are enrolled in the Medical Surveillance Program.

Site Health and Safety Officer

For this project, Ms. Julie WestHoff will act as the Site Health and Safety Officer (SHSO). Responsibilities of the SHSO include:

- o Enforcing the Health & Safety Plan
- o Stopping work, as required, to ensure personal safety and protection of property, or when non-compliance with safety requirements is found
- o Determine routes to emergency medical facilities, providing telephone numbers (including poison control center), and arranging for emergency transport to medical facilities
- o Notifying local emergency center of the nature of the site operations and providing their telephone number in site-specific addenda
- o Entering the exclusion zone in emergencies when at least one other member of the field team is available to stay behind and notify emergency services (or after emergency services have been notified)
- o Examining field team members for symptoms of exposure or stress
- o Ensuring that each team member has been provided the proper medical clearance by a qualified medical consultant, and monitor all team members to determine compliance with the applicable physical requirements as stipulated in the Health & Safety Plan
- o Documenting any changes to the Health & Safety Plan.

2.0 SITE-SPECIFIC HEALTH AND SAFETY INFORMATION AND PROCEDURES

The field activities to be conducted at the Richards-Gebaur AFB present a variety of potential hazards to field personnel. This section addresses those potential exposures, both chemical and physical, that all personnel should be cognizant of while participating in activities at this base.

2.1 Chemical Hazards

The chemical hazards associated with this investigation result from potential exposure to soils and groundwater contaminated with petroleum products. The source of the contamination is possibly from an abandoned jet fuel pipeline or a localized spill that occurred when building adjacent to the Fire Valve Area was utilized for motor pool operations. The primary source of

potential exposure to hazardous materials is through the inhalation of volatile organic vapors or contaminated dust generated during drilling and sampling activities. Ingestion of contaminated material is a secondary concern, and usually occurs through accidental means, inadequate decontamination, or poor personal hygiene practices. Irritation and absorption resulting from dermal contact is also of concern; therefore, exposure via the cutaneous route should be avoided. Table D-1 contains permissible exposure levels and Appendix D-2 includes IRP Toxicology Guides. The information contained in these guides includes the information normally found in MSDS sheets plus additional information such as expected fate and transport in different media.

The potential health hazards associated with investigative activities at Richards-Gebaur AFB include exposure to the following chemicals.

Benzene. Benzene is a clear, colorless, noncorrosive, highly flammable liquid with a strong, pleasant odor. Benzene is a component of petroleum and may be a contaminant in gasoline at a range of 0.3 percent to 2 percent by volume. Acute exposure to high concentrations of benzene may produce central nervous system depression, headache, nausea, dizziness, convulsions, coma, and death. Benzene is poorly absorbed through unbroken skin; however, prolonged or repeated contact may cause erythema, blistering, or dry, scaly dermatitis. Benzene is well known for its chronic toxic effects, primarily its effects on the hematopoietic system, causing such disorders as leukemia and aplastic anemia.

Toluene. Toluene is a clear, colorless liquid with a sweet, pungent, benzene-like odor. Toluene is a component of motor and aviation fuels. Exposure to toluene may cause irritation to the eyes, upper respiratory track, and skin with dermatitis developing after repeated or prolonged contact. In addition, toluene is a central nervous system toxicant, producing symptoms of exhilaration, headache, and in high concentrations, coma, and death.

Xylene. Xylene exists in three isomeric forms: ortho, meta, and para, with each having its own distinct physical properties. Exposure to xylene occurs primarily via inhalation, and to some extent by absorption through the intact skin. Effects from exposure to xylene include irritation to the eyes, nose, and throat, as well as a narcotic effect to the central nervous system. Symptoms of overexposure to xylene include headache, dizziness, gastric discomfort, dryness of throat, and feelings of slight inebriation. Exposure to high concentrations (10,000 ppm) can produce unconsciousness and death.

Ethylbenzene. Ethylbenzene is a colorless liquid with a characteristic aromatic odor. The acute toxicity of ethylbenzene is low, with exposure to high concentrations producing a narcotic effect similar to benzene. Ethylbenzene is an irritant to the skin, eyes, and nose. Repeated contact results in a reddening and blistering of the skin.

TABLE D-1

ESTABLISHED EXPOSURE LIMITS

CONTAMINANT	1) OSHA PEL	2) ACGIH TLV	3) NIOSH IDLH
Benzene ppm	1 ppm	0.1 ppm (proposed)	3,000
Toluene ppm	100 ppm	50 ppm (proposed)	2,000
Xylene ppm	100 ppm	100 ppm	1,000
Ethylbenzene ppm	100 ppm	100 ppm	2,000
JP-4 ppm	400 ppm	None	10,000

1) OSHA Permissible Exposure Limit (PEL), Time Weighted Average (TWA) is the employee's average airborne exposure in any 8-hour workshift of a 40-hour work week which shall not be exceeded.

2) ACGIH Threshold Limit Value (TLV) is the time-weighted average concentration for a normal 8-hour workday, 40-hour work week to which nearly all workers may be exposed, day after day, without adverse effects.

3) NIOSH Immediately Dangerous to Life or Health (IDLH) represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.

Petroleum Compounds. A number of hydrocarbon mixtures are obtained by refining crude petroleum with the precise composition of each compound varying and each is distinguished by its boiling range. These compounds contain both saturated and unsaturated aliphatic and alicyclic hydrocarbons, in addition to aromatic compounds such as benzene, toluene, and xylene.

2.2 Physical Hazards

The physical hazards associated with the activities to be performed at Richards-Gebaur AFB include: tripping and falling hazards; potential cold stress; working in close proximity to heavy equipment (i.e., drill rig); noise; and flammable materials.

Slipping, Tripping, and Falling Hazards. Field personnel must be aware of site conditions that may present safety hazards. Steel toe, steel shank boots must be worn by site personnel at all times. In addition, Personal Protective Equipment (PPE) worn on site can reduce one's dexterity, narrow the field of vision, and diminish communication and hearing capabilities.

Heavy Equipment Operations. While on site, field personnel will be working around heavy equipment (e.g., drill rig/backhoe) and will adhere to the following requirements:

- Not walk under suspended loads
- Not walk in front or in back of moving equipment
- Field personnel not directly involved with heavy equipment operations will respect a 10-foot exclusion zone around each piece or group of operating equipment.

Drilling Operations. Before beginning any site work, Richards-Gebaur AFB personnel will locate underground utilities and issue an appropriate permit prior to the commencement of any digging or drilling activities. Two weeks advance notice to the base Point of Contact (POC) is necessary to ensure base personnel have adequate lead time to accomplish this. Additionally, before beginning any site work, the subcontractor will inspect their equipment to ensure proper operation.

Flammable Materials. Equipment that requires either diesel or other fuel may be serviced daily at the site by a portable tank truck or hand held containers. Since diesel is considered a combustible liquid (flash point 110 - 190 degrees F) and gasoline is extremely flammable, the following precautionary measures will be followed:

- A 50-foot distance will be maintained between flammable materials and ignition sources, and

- o Use of non-sparking, explosion-proof equipment when working with flammables.

Working in Temperature Extremes. Proposed investigative activities are scheduled for late November or early December; therefore, field personnel should be familiar with the symptoms of cold stress.

Cold Stress. Two factors influence the development of cold injury: ambient temperature and wind velocity. (Note: Wind chill is used to describe the chilling effect of moving air in combination with low temperatures - see Table D-2). Personnel working in low temperatures are subject to injury to exposed body surfaces (e.g., frostbite) and profound generalized cooling of the body (hypothermia).

Frostbite. Frostbite is caused by the constriction of blood vessels in the extremities, which causes a decreased flow of warm blood supply and can result in tissue damage. Three stages of frostbite can result, and are described as follows:

1. Frostnip or incipient frostbite is characterized by a blanching or whitening of the skin.

2. Superficial frostbite is characterized by the skin having a white or waxy appearance and being firm to the touch (tissue beneath is resilient).

3. Deep frostbite involves tissues that are cold, pale, and solid, and is considered an extremely serious injury.

The areas of the body that have high surface area to volume ratio, such as fingers, toes, and ears, are the most susceptible to frostbite.

Systemic Hypothermia. Systemic hypothermia is caused by prolonged exposure to low temperatures or to rapid drop in temperature. Hypothermia is characterized by shivering, numbness, drowsiness, muscular weakness, and a low internal body core temperature, which can lead to unconsciousness and death.

First Aid. With both frostbite and hypothermia, the affected areas need to be warmed quickly. The victim should be immersed in warm (not hot), water; in all cases, medical assistance should be sought immediately.

Preventive Measures for Working in Cold Weather.

- o Field personnel should be fully rested prior to going on the site in cold temperatures. The danger of frostbite increases when a person is tired or ill.

Estimated Wind Speed (mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	**LITTLE DANGER** in < hr with dry skin. Maximum danger of false sense of security.				**INCREASING DANGER** Danger from freezing of exposed flesh within 1 minute.				**GREAT DANGER** Flesh may freeze within 30 seconds.			
	Trenchfoot and immersion foot may occur at any point on this chart.											

Note: *Developed by U.S. Army Research Institute of Environmental Medicine, Natick, MA.
Source: Threshold Limit Values and Biological Exposure Indices, AC6IH.

TABLE D-2

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)*

- Field personnel should abstain from drinking alcohol, smoking, using chewing tobacco or bathing immediately before going out into the cold.

- Several layers of clothing should be worn by field personnel. Layers of clothing insulate the body more effectively than one thick layer alone.

    1. The first layer, known as the "vapor transmission layer" or "perspiration transfer layer", acts to absorb body moisture and transmit it away from the body and help keep it dry.

    2. The second layer, an insulating layer, traps air around the body.

    3. The third layer is the protective layer and helps protect the insulating layer from wind and moisture.

- In temperatures of 20 degrees F or less (including wind chill factor), it is recommended that field personnel wear the following:

    1. Insulated coveralls

    2. Wool socks

    3. Insulated steel toe boots

    4. Long underwear (e.g., chlorofibre or polypropylene) to absorb perspiration; in addition, Saran coated Tyvek may be used to add another layer of protection and minimize the effects from wind and moisture.

    5. Head protection (e.g., wool cap) should be worn to reduce heat loss.

- Sufficient circulation should be allowed to both feet and hands. Laces on insulated boots should not be tightened to a point that can reduce circulation, which increases the possibility for frostbite.

- Access to warm shelter should be available.

- A temperature-dependent work regimen should be established to limit periods of outdoor activity.

- Personnel should not wear jewelry when working in cold temperatures.

Noise. Heavy equipment (e.g., drill rig) operations may produce sound pressure levels exceeding 85 dBA, 8-hour Time Weighted Average (TWA), which would require the use of hearing protection. Long-term exposures to excessive sound pressure levels can lead to temporary or permanent hearing loss and may also put stress on other parts of the body by causing abnormal secretions of hormones and tensing of muscles. Hearing protection (e.g., aural inserts or ear muffs) must be worn when in close proximity to operations involving heavy equipment or machinery producing excessive noise levels (assume hazardous noise levels are generated when the ability to converse requires elevating voice levels when working around heavy equipment.

3.0 SAFE WORK PRACTICES

Project personnel involved in the handling, sampling, and/or ultimate disposal of, or otherwise potentially exposed to site-specific contaminated materials or hazardous materials related to the field work, are subject to this Health and Safety Plan. In addition, supervisory and regulatory personnel who visit the project site during the investigative/sampling activities will be provided with a copy of this Health & Safety Plan and will be notified of the hazards present at the site.

All personnel are responsible for continuous adherence to the safety procedures outlined here during the performance of the investigative/sampling activities. In no case may work be performed in a manner that conflicts with the intent of, or the inherent safety and environmental cautions expressed in these procedures. After due warning, personnel who violate safety procedures will be dismissed from the site and potentially terminated. All field personnel shall be properly trained in health & safety regulations associated with handling hazardous materials and the safe operation of equipment. All onsite personnel will be trained, as necessary, according to the specifications set forth by Title 29 CFR 1910.120 and this document.

The following personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. These guidelines represent the minimum standard procedures for reducing potential risks associated with the sampling/investigative activities and must be followed by all field personnel at all times.

3.1 Tetra Tech Personnel

- At least one copy of this plan will be available at the job work site at all times.
- All field personnel are required to attend a pre-job safety orientation meeting prior to the start of field activities and sign-off on attending the meeting in addition to reading and signing the site-specific Health and Safety Plan.
- A tailgate safety meeting will be conducted daily, prior to the start of that day's field operations.

- The Project Task Manager or SHSO must be informed in advance of any medical restrictions that site personnel may have. Personnel who take medications that will interfere with their ability to work safely and/or use PPE, will be prohibited from participating in field activities.

- The work site will be marked as a regulated area and will be divided into the work zones defined in Section 8.1, Regulated Areas.

- Contaminated protective equipment, such as respirators, boots, etc., will not be removed from the regulated area until it has been decontaminated or properly packaged and labeled.

- Legible and understandable precautionary labels will be affixed prominently to containers or contaminated waste and clothing.

- Removal of contaminated soil from protective clothing or equipment by blowing, shaking, or any other means that disperses contaminants into the air is prohibited. Refer to Section 8.2 for decontamination procedures.

- Eating, chewing, drinking, smoking, taking certain medications, and similar activities are prohibited in the exclusion zone. Avoid all hand-to-mouth contact if contamination of clothing or body is possible. Any open wounds must be covered with an airtight bandage; ideally, someone with an open wound should not enter the work site. Persons with lesions or sores in the mouth. eyes. or nose will not enter the work site.

- All sanitation facilities will be located outside the exclusion and contamination reduction zones. Decontamination is required before using such facilities.

- Personnel will avoid direct contact with contaminated materials, unless necessary for sample collection or required observation. The protective gloves specified in this Health & Safety Plan will be worn at all times when handling samples. or any other potentially contaminated items.

- While operating in an established exclusion zone, personnel will use the "buddy system". No person may enter potentially hazardous work sites alone. No one should leave another individual alone at a potentially hazardous work site.

- Facial hair that may interfere with the satisfactory fit of respiratory protective equipment will not be allowed. Personnel with beards will not be allowed to perform hazardous waste work requiring the use of respirators.

- Personnel may not wear loose, ragged, or poorly fitted clothing, dangling jewelry, or rings when working around equipment or tools. Long hair must be restrained so that is does not get caught in moving parts. Any of these items can become snagged in moving equipment and result in serious injury.

- Weather conditions and wind direction will be tracked by the SHSO.

- Personnel will be alert to potentially changing exposure conditions, such as perceptible odors or unusual appearance of soil samples. This information will be noted in the site-specific log book.

- Personnel are not permitted to enter a confined space under this Health and Safety Plan.

- If work is necessary inside buildings or poorly lighted areas, a minimum of 50-foot candles is required.

- Personnel will wash hands thoroughly upon leaving any area of suspected contamination.

- Personnel should be alert to any unusual behavior on the part of other workers that might indicate distress, disorientation, or other ill effects. Personnel should also be alert to any unusual changes in their own condition; never ignore warning signs or hesitate to report them at once. Personnel will inform each other of symptoms of nausea, dizziness, headache, or respiratory or eye irritation.

- Medicine and alcohol can heighten the effects of exposure to toxic chemicals and heat. Prescribed drugs should not be taken by field personnel unless specifically approved by a qualified physician. The physician should be informed by the employee of the potential for exposure to contaminants at the site. Alcoholic beverage intake should be avoided.

- Contaminated materials will be stored in tightly closed containers in well-ventilated areas.

- Containers will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.

- Emergency equipment will be located in an area that allows employees easy access to the equipment.

- o All areas that have been determined as uncontaminated inside the regulated area will be identified. Use of these areas by contaminated personnel, equipment, etc., will be regulated and limited for use as decontamination zones only.

3.2 Visitors

Visitors and observers to either of the Richards-Gebaur AFB sites covered by this Health & Safety Plan will receive the same information that is discussed at the daily tailgate meeting or an equivalent overview by the SHSO. Additionally, visitors and observers at the site will be expected to abide by the following:

- o All visitors/observers will stay outside the exclusion zone and remain within the boundaries of the clean zone during the extent of their stay.

- o Any visitors/observers requesting to observe work within the exclusion zone must wear appropriate PPE and fully comply with the site Health & Safety Plan before entering the exclusion zone. If respiratory protective devices are necessary, visitors who wish to enter the contaminated zone must provide documentation that they have had a complete physical examination and hazardous waste training. Also, they must be able to document respirator fit testing within the past six months.

4.0 EMPLOYEE TRAINING

All employees assigned to the project covered by this Health & Safety Plan will be trained in accordance with the requirements of 29 CFR 1910.120(e) and understand the potential hazards associated with sites at Richards-Gebaur AFB. All field personnel have received 40 hours of training covering site safety plans; safe work practices; nature of anticipated hazards; handling emergencies and self-rescue; rules and regulations for vehicle use; safe use of field equipment; proper use and limitations of air monitoring equipment; handling, storage, and transportation of hazardous materials; employee rights and responsibilities; use, care, and limitations or personal protective clothing and equipment; and safe sampling techniques. All employees are properly trained in the use, capabilities, limitations, and maintenance of air-purifying respirators and SCBAs.

In addition, each employee has received a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor and also received annual refresher training in accordance with the regulations. As required under OSHA regulations, all personnel will have been qualitatively fit-tested prior to wearing a respirator (fit-testing of Tetra Tech employees is performed every six months). The Task Manager and SHSO are trained in the proper selection of respiratory protection, protective clothing, air monitoring techniques, confined space entry, hazard recognition and evaluation, and exposure symptoms for the

contaminants of concern. Documentation that Tetra Tech employees have received the required training are attached in Appendix D-3.

Pre-Entry Briefings and Informational Materials

The following training sessions and informational materials will be provided at the site.

- Tailgate Safety Meetings - A tailgate safety meeting will be conducted at the beginning of each work day. Topics to be discussed will include, but not be limited to proposed work activities, level of PPE to be worn, safe work practices, air monitoring requirements, and health hazards associated with the contaminants at the site. The tailgate safety meeting log is included in Appendix D-4.

- If available, Material Safety Data Sheets (MSDS) for contaminants present at the site will be reviewed by all site personnel prior to the start of the investigative/sampling activities and will be included in the Health & Safety Plan. MSDSs were not readily available; IRP Toxicology Guides were substituted and can be found in Appendix D-2.

- Site-Specific Health and Safety Plan - Prior to the start of the investigative activities all personnel entering the site will have read the Health & Safety Plan and signed the Consent Agreement located in Appendix D-1.

5.0 MEDICAL SURVEILLANCE

The following section describes Tetra Tech's Medical Surveillance Program.

5.1 Physical Examination

A sound Medical Surveillance Program is essential to assess and monitor worker health and fitness prior to and during work at hazardous materials sites. As required by Tetra Tech Policies and Procedures and federal regulations, all Tetra Tech personnel on the site will have successfully completed an initial examination and participate in periodic examinations.

The initial/baseline examination consists of the following parameters:

- In-depth occupational history

- Comprehensive medical examination

- Complete physical examination, including physical capacity involving both the cardiovascular and musculoskeletal system

- o Respirator fitness examination
- o Heat stress tolerance determination
- o Laboratory tests, including a comprehensive blood chemistry profile and a complete blood count (CBC) with differential to assess the hematopoietic system. liver function, kidney function, and general health status
- o Spirometry, which will include measurements of forced expiratory volume (FEV1) and forced vital capacity (FVC)
- o Vision examination to assess refraction, depth perception, peripheral vision, and color vision
- o Audiometric tests performed at 500, 1k, 2k. 3k, and 6k hertz (Hz) pure tone
- o Chest x-ray requiring 14 x 17 inch posterior/anterior and lateral views
- o Electrocardiogram (ECG) - one standard 12-lead resting cardiogram
- o Biological monitoring, which includes a heavy metal screen and serum pesticides.

The periodic examination mirrors the initial/baseline examination with the exception of audiometric testing, chest x-ray, ECG, and biological monitoring. These parameters are performed only when clinically indicated or if exposure to toxins or physical hazards (i.e., noise) warrants the need.

The examining physician provides a written statement on the ability of the employee to perform the assigned duties; medical approval for field personnel to wear respirators; recommendations for additional testing that may be required for the employee, based on examination results; and a discussion with the employee at his/her request. The employee will be informed of any medical conditions that would result in work restrictions or that would preclude him/her from working with hazardous materials.

All subcontractor personnel who have potential for exposure to hazardous materials will have successfully completed a physical examination. The cost for medical surveillance will be paid by the subcontractor. All physicals will be performed by a physician who is Board Eligible/Board Certified in Occupational Medicine.

5.2 Medical Records

In accordance with 29 CFR 1910.120 and 29 CFR 1910.20, employee medical records will be maintained for the duration of employment and 30 years after termination of employment. In addition, employee exposure records will be maintained for a duration of 40 years, or for the duration of employment plus 20 years, whichever is longer. All medical records will be maintained by the examining physician. Medical records retained in the Tetra Tech office will contain the following information:

- Medical surveillance requirements
- The name and employee number of each employee enrolled in the Medical Surveillance Program
- The physician's written opinion, recommended limitations, and results of examinations and tests.

5.3 Injury and Illness Treatment

Overexposure to hazardous materials can be harmful, even fatal, to an employee; therefore, immediate actions to these incidents is required.

- If an injury/illness is the result of a chemical exposure, the SHSO and/or PHSM will promptly initiate the steps necessary to identify the chemical(s). Chemical identification will be accomplished through the use of monitoring equipment (e.g., photoionization or flame ionization detectors in conjunction with detector tubes and/or conventional industrial hygiene monitoring), and any prior sampling results that are available.
- The PHSM or SHSO will provide the examining physician with the identity of the chemicals and the amount/concentration to which the individual was exposed (if available), length of time of exposure, and MSDS(s) on the chemicals of concern, if available.
- Any injury/illness not limited to a first-aid response will require the SHSO to immediately notify the PHSM and Corporate Health and Safety Manager (CHSM). The notification allows the coordination of internal resources to assist the treating physician in rendering appropriate care.
- Any employee of Tetra Tech or of a subcontractor who is suspected of having an overexposure to the chemicals on the site will be given a complete physical examination. Any employee or contractor who develops a lost-time illness or

sustains a lost-time injury will be re-examined. The physician will certify that the employee is fit to return to work.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment (PPE) outlined below has been selected according to the Scope of Work, site hazards, intended use, and duration of potential employee exposures. Field personnel have received training in proper maintenance and storage of PPE, decontamination, donning and doffing procedures, inspection and monitoring effectiveness, and limitations of PPE. The need for donning Level A or Level B is not anticipated for the proposed sampling/investigative activities; however, descriptions for all levels of protection have been included in Table D-3 in the event upgrading to level B or A should become necessary.

6.1 Respiratory Protection

- Only properly cleaned, maintained, National Institute of Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) approved respirators will be used on site, with a cartridge approved for specific contaminant(s) expected to be encountered (i.e., combination organic vapor/HEPA filter cartridge).

- Selection of respirators, as well as any decisions regarding upgrading or downgrading of respiratory protection, will be made by the PHSM or the SHSO.

- Used air-purifying cartridges and other PPE will be replaced at the end of each shift or when loadup or breakthrough occurs.

- Positive and negative pressure tests will be performed each time the respirator is donned.

- Only employees who have been medically approved, pre-issue qualitative fit tested, and fit tested every six months thereafter will be allowed to work in atmospheres where respirators are required.

- No employee will be assigned to tasks requiring the use of respirators if, based on the most recent examination, a physician determines that the employee will be unable to function normally wearing a respirator or that the safety or health of the employee will be impaired by the use of a respirator.

- The user will have received instruction in the proper use of respirators and their limitations (refer to Section 4.0).

TABLE D-3

ELEMENTS OF LEVELS OF PERSONAL PROTECTIVE EQUIPMENT

LEVEL A — Maximum Skin and respiratory protection.

Used for highly toxic or unknown substances.

Consists of SCBA or equivalent, fully encapsulating suit, steel-toed, and steel-shanked, chemical resistant boots, and two layers of gloves.

May include hard hat, outer disposable protective cocoon to protect the suit and work gloves.

LEVEL B — Maximum respiratory protection, but skin protection is slightly less.

Used for hazardous vapors with little or no direct contact hazard, and unknown situations where no contact with the release is expected.

This is the minimum level recommended for initial assessments of sites presenting unknown hazards

Consists of SCBA; one or two-piece, chemical protective garment (one piece is preferred); steel-toed, steel-shanked, chemical resistant boots; two layers of gloves.

Optional equipment includes hard hat with or without face shield; disposable outer garment, gloves, and booties to ease decontamination procedures.

LEVEL C — **Used for known situations that meet the criteria for using air purifying respirators.**

Consists of the same clothing as the protection level above, but with air purifying respirator in place of an SCBA.

May include hard hat with or without face shields; disposable outer gloves and booties; and an escape mask.

LEVEL D — Used in areas known to be free of contaminants.

Normal work outfit, modified as necessary to be appropriate for site conditions (i.e., hard hat for overhead dangers such as drilling; Tyvek or Saranex for splash protection).

- o Respirators will be cleaned and disinfected after each use.
- o Respirators will be stored in a convenient, clean, and sanitary location on the site.
- o Respirators will be inspected prior to donning and during cleaning; worn or deteriorated parts will be replaced.
- o Regular surveillance of the work area will be conducted by the SHSO to determine the appropriateness of the respiratory protection being worn.
- o Excessive facial hair (beards) prohibits proper face fit and effectiveness of respirators. Persons required to wear full-face respirators will not have beards, wide mustaches, goatees, extended sideburns, or Fu Manchu mustaches. All personnel wearing full-face respirators will be required to be clean shaven before each day's work shift.
- o Regular eyeglasses cannot be worn with full-face respirators because they interfere with the facepiece seal; therefore, lens inserts must be used.

6.2 Levels of Protection

Protective clothing is necessary to prevent contact with potentially hazardous concentrations of chemical agents. Drilling activities will be performed in Level C PPE due to the contaminants present and the potential for dust generation unless field monitoring demonstrates otherwise. Each new drilling location must be monitored before a decision to downgrade PPE can be made. Level D PPE will provide sufficient protection for support personnel. Table D-4 presents the criteria necessary for upgrading of PPE.

7.0 SITE MONITORING

Air monitoring will be conducted throughout the course of the sampling/investigative activities to determine employee exposure to airborne contaminants. The monitoring results will dictate the selection and appropriateness of personal protective equipment.

7.1 Site Monitoring Strategy

A preliminary survey of existing air quality conditions will be performed prior to the start of the investigative/sampling activities to establish baseline levels. This survey will be performed prior to work. These surveys will focus on the contaminant reduction zone upwind from the investigative activities, locations where field personnel may assemble or congregate, the locations of field activities, and confined areas where gases may be trapped.

TABLE D-4
DECISION CRITERIA FOR UPGRADING OF
PERSONAL PROTECTIVE CLOTHING

Agent	Monitoring Instrument	Decision Level	Required Protection
Organics (Volatile)	Photoionization Detector (PID)	Background	Modified Level D
Organics (Volatile)	PID	1-5 ppm above Background	Level C
Organics (Volatile)	PID	5-500 ppm above Background	Level B (Not anticipated)
Dust	Aerosol monitor*	When a 5 minute TWA is >0.05 mg/m^3 ** Above background	Level C
Flammable Vapors	CGI	<10% LEL	Continue with caution
	CGI	10% - 20% LEL	Continue activities with extreme caution as elevated levels may be encountered. Continuous monitoring required.
	CGI	>20% LEL	Leave area immediately; explosion hazard exists.

* Site personnel should record the TWA at the end of the day and also the SA at the end of each shift by pressing either the TWA or the SA key, which will display the aerosol concentration.

** The decision level is based on the PEL of lead. If background dust exceeds 9.99 mg/m^3, the sensitivity of the meter is reduced to 0.1 mg/m^3. In that event, the action level will be 0.1 mg/m^3 above background.

Field personnel will perform air monitoring throughout site activities. Air monitoring is required to select the level of PPE to be worn, to establish the work zones. and to document exposure levels (Table D-1).

Air monitoring to be performed includes:

Dust: A Miniram aerosol meter will be utilized to determine airborne particulate hazards that may be present during soil and dried sediment sampling activities. The contaminants of concern at the site are either particulates or organic compounds adsorbed to sediment particles. Ongoing air monitoring for total particulates is required to determine the level of respiratory protection to be worn. Monitoring for airborne particulates will be performed initially, prior to the start of the sampling activities, and during soil and dried sediment sampling.

Organic Compounds: An HNu photoionization detector (PID) or a flame ionization detector (FID) will be utilized to determine the levels of organic compounds that may be present during drilling operations. Both these instruments are considered broad spectrum instruments capable of measuring more than one chemical using the same process. This means that if more than one compound or contaminant is present (i.e., benzene and xylene) these instruments are not capable of differentiating between them.

The HNu detects organic chemicals by drawing the vapor through a light beam and measuring to what extent the gas is ionized. The HNu is particularly sensitive to volatile organics, but will detect numerous other chemicals as well This survey provides real time information over a fairly wide range (0 to 2,000 ppm). The PID will not normally discern between various chemicals; however, three separate lamps are available (i.e., different ionization energy sources) which can allow some gross differentiation of materials. Also, some organics will generate a greater response than others, possibly giving a false reading.

Both instruments provide only a grab sample; this means the concentration measured is valid only at the location measured. Multiple measurements must be taken in a given area to provide an idea of the actual distribution of contaminants. The characteristics, including limitations for the PID and FID, are listed in Tables D-5 and D-6, respectively.

Radiation: Prior to performing sampling activities, a radiation survey of the site will be performed. In the event that radiation levels are detected at twice the background level, personnel will immediately leave the site, perform proper decontamination procedures, and notify the Corporate Health Physicist to determine the next course of action.

Perimeter Air Monitoring: Perimeter air monitoring will be performed during intrusive activities (i.e.. drilling) to determine the extent, if any, of migration of contaminants off the site. Perimeter air monitoring will be performed at a frequency of twice a day (i.e., mid-morning and mid-afternoon). If

CHARACTERISTICS OF DIRECT-READING INSTRUMENTS FOR GENERAL SURVEY - PHOTOIONIZATION DETECTOR

TABLE D-5

INSTRUMENT	HAZARD MONITORED	APPLICATION	DETECTION METHOD	LIMITATIONS	EASE OF OPERATION	GENERAL CARE & MAINTENANCE	TYPICAL OPERATING TIMES
Ultraviolet (UV) Photoionization Detector (PID)	Many organic and some inorgainic gases and vapors.	Detects total concentrations of many organic and some inorganic gases and vapors. Some identification of compounds is possible if more than one probe is used.	Ionizes molecules using UV radiation; produces a current that is proportional to the number of ions.	Does not detect methane. Does not detect a compound if the probe used has a lower energy level than the compound's ionization potential. Response may change when gases are mixed. Other voltage sources may interfere with measurements. Readings can only be reported relative to the calibration standard used. Response is affected by high humidity.	Effective use requires that the operator understand the operating principles and procedures, and be competent in calibrating, reading, and interpreting the instrument.	Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories.	10 hours; 5 hours with strip chart recorder.

Reference: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

CHARACTERISTICS OF DIRECT-READING INSTRUMENTS FOR GENERAL SURVEY - FLAME IONIZATION DETECTOR

TABLE D-6

INSTRUMENT	HAZARD MONITORED	APPLICATION	DETECTION METHOD	LIMITATIONS	EASE OF OPERATION	GENERAL CARE & MAINTENANCE	TYPICAL OPERATING TIMES
Flame Ionization Detector (FID) with Gas Chromatography Option	Many organic gases and vapors.	In survey mode, detects the total concentrations of many organic gases and vapors. In gas chromatography (GC) mode, identifies and measures specific compounds. In survey mode, all the organic compounds are ionized and detected at the same time. In GC mode, volatile species are separated	Gases and vapors are ionized in a flame. A current is produced in proportion to the number of carbon atoms present.	Does not detect inorganic gases and vapors, or some synthetics. Sensitivity depends on the compound. Should not be used at temperatures less than 40 degrees F (4 degrees C). Difficult to absolutely identify compounds. High concentrations of contaminants or oxygen deficient atmospheres require system modification In survey mode, readings can be only reported relative to the calibration standard used	Requires experience to interpret data correctly, especially in the GC mode. Specific identification requires calibration with the specific analyte of interest.	Recharge or replace battery. Monitor fuel and/or combustion air supply gauges. Perform routine maintenance as described in the manual. Check for leaks.	8 hours; 3 hours with strip chart recorder.

Reference: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.

results of the air monitoring indicate migration of contaminants is occurring, operations will cease until engineering controls can be implemented (dust suppression) to minimize contaminant generation.

7.2 Monitoring Recordkeeping

The SHSO will be responsible for establishing and maintaining records of all required monitoring as described below:

- Employee name and task description.
- The date, time, pertinent task information (such as boring number, depth of hole, meter reading, temperature/weather conditions, etc.), and relevant comments will be written in the site-specific logbook that will be available for inspection at all times.
- A description of the analytical methods, equipment used, and calibration data.
- Type of personal protective equipment worn.
- Any engineering controls used to reduce exposure.

7.3 Calibration

All monitoring equipment will be calibrated daily, in accordance with the manufacturer's recommendations, prior to any field use. In addition, at the end of each day of field activities, the monitoring equipment used will be checked to ensure that calibration of the instrument was maintained and that accurate measures were obtained. The dates, times, and results of all calibration procedures will be documented. Instrument instruction and calibration procedures are included in Appendix D-5.

8.0 DECONTAMINATION AND SITE CONTROL

Harmful materials can be transferred into clean areas, exposing unprotected personnel. Or in removing contaminated clothing, personnel may contact contaminants on the clothing or inhale them. To prevent such occurrences, methods to reduce contamination and decontamination procedures must be developed and implemented before anyone enters a site, and must continue (modified when necessary) throughout site operations.

Decontamination consists of physically removing contaminants and/or changing their chemical nature to innocuous substances. How extensive decontamination must be depends on a number of factors, the most important being the type of contaminants involved. The more harmful the contaminant, the more extensive and thorough decontamination must be. Less harmful contaminants may require less decontamination. Combining decontamination, the correct method of doffing personnel protection equipment, and the use of site work zones minimizes cross-

contamination from protective clothing to wearer, equipment to personnel, and one area to another.

8.1 Regulated Areas

To reduce the accidental migration of hazardous substances from the contaminated area, site work zones will be designated. The following three zones will be established, as shown on Figure D-2.

Exclusion Zone- This zone includes the actual areas of contamination. This zone has the highest inhalation exposure and/or presents a high probability of skin contact with cutaneous or percutaneous affecting chemicals.

Contamination Reduction Zone- This zone includes the areas immediately surrounding the exclusion zone. This zone has the next highest inhalation hazard but does not have a high probability of skin contact with cutaneous or percutaneous affecting chemicals. This zone is the area where decontamination occurs and will be established near the active portions or the exclusion zone as designated by the PHSM or SHSO.

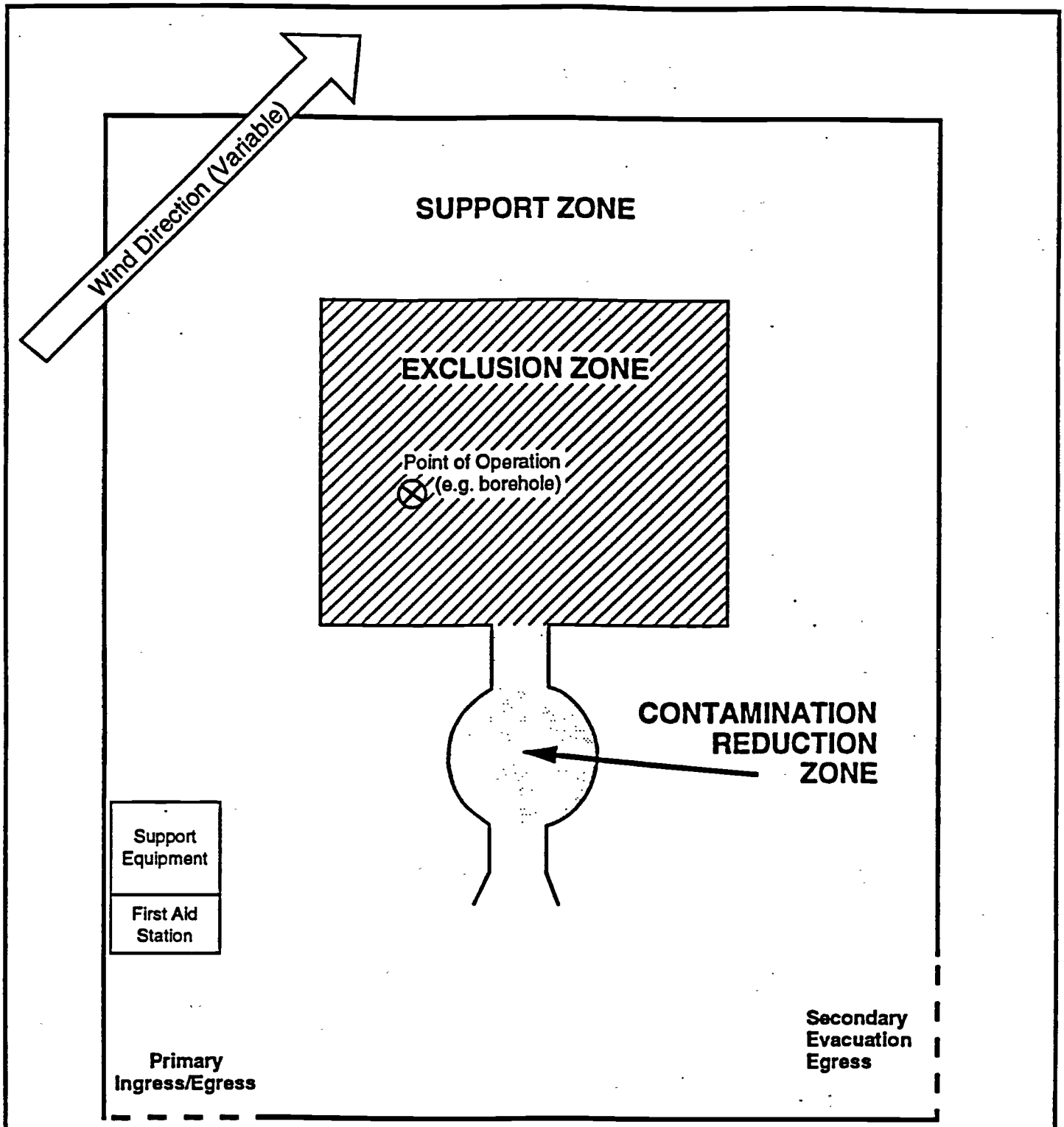
Support (Clean) Zone- This will be an uncontaminated area outside and upwind of the exclusion zone, where support activities are conducted.

Access to contaminated work areas (exclusion and contamination reduction zones) will be regulated and limited to authorized persons.

8.2 Personnel Decontamination

The purpose of decontamination is to limit the spread of contaminated materials from the exclusion zone. This is accomplished through a step-by-step procedure whereby the protective clothing and equipment is either washed or disposed. The SHSO should exercise judgement in establishing the contamination reduction zone. Monitoring during work activities may indicate the need for additional stations under certain conditions. It is also possible that stations may be combined. Allowances must be made for the type of protective equipment being worn; for example, nondisposable, steel-toed neoprene outer boots need not be removed if properly decontaminated.

The decontamination procedures presented here for Levels D and C are very similar; the difference being extra stations and additional equipment for Level C decontamination (i.e., respirator change or removal). The final disposition of spent PPE will be determined after receipt of laboratory analyses. Contaminated and potentially contaminated PPE will be stored in sealed containers within a secure area provided by the U.S. Air Force until it is sent off site for final disposal.



United States Air Force	
Richards-Gebaur AFB	
General Work Zone Delineation	Figure D-2

8.2.1 Level D Decontamination

Station 1: **Segregated Equipment Drop.** Deposit equipment used on the site (i.e., tools, sampling devices and containers, monitoring equipment, clipboards, etc.) on a plastic drop cloth.

Equipment: Plastic drop cloth

Station 2: **Boots and Gloves Wash and Rinse.** Scrub boots and gloves with decontamination solution or detergent/water. Rinse gloves and boots with hand pump spray device.

Equipment: Two wash tubs
Hand pump spray device
Water
Detergent
Scrub brushes

Station 3: **Boots, Gloves and Outer Garment Removal.** Decontaminated boots and outer gloves are removed and placed outside the exclusion zone. Inner gloves and Tyvek™ suit are deposited in containers lined with plastic.

Equipment: Containers
Plastic liners

Station 4: **Field wash and/or decontamination unit.** Thoroughly wash hands and face, and shower as soon as possible.

Equipment: Water
Wash basin/bucket
Soap

8.2.2 Level C Decontamination

Station 1: **Segregated Equipment Drop.** Deposit equipment used on the site (i.e., tools, sampling devices and containers, monitoring equipment, clipboards, etc.) on a plastic drop cloth. Each piece of equipment will be contaminated to a different degree. Segregation at the drop reduces the probability of cross contamination.

Equipment: plastic drop cloths

Station 2: **Boots and Gloves Wash and Rinse.** Scrub boots and gloves with decontamination solution or detergent/water. Rinse gloves and boots with hand pump spray device.

Equipment: Two wash tubs
Hand pump spray device
Water
Detergent
Scrub brushes with long handles

Station 3: **Outer Glove Removal.** Remove decontaminated boots and outer gloves with accompanying tape. Tape should be placed in a container with a plastic liner.

Equipment: One container
Plastic liner

Station 4: **Canister/Cartridge Change.** If a worker leaves the contaminated zone to change a canister/cartridge on his/her respirator, this is the last step in the decontamination procedure. Once the worker's canister/cartridge is exchanged, the outer gloves and boot covers are donned and joints taped. The worker may then return to the exclusion zone. Used canisters or cartridges are properly disposed at the end of each day.

Equipment: Respirator canisters/cartridges
Tape
Outer gloves

Station 5: **Boots, Gloves and Outer Garment Removal.** Remove boots, gloves (inner), and outer garment. The outer garment and inner gloves should be deposited in a plastic-lined container.

Equipment: Containers
Plastic liners

Station 6: **Respiratory Protection Removal.** Remove the respirator facepiece, deposit used cartridges in a plastic-lined container, and wipe the facepiece with clean water and paper towels. Respirators should be cleaned with the disinfectant supplied by the manufacturer of the respirator at the end of each day.

Equipment: Container
Plastic liner
Paper towels

Detergent solution
Rinse water

Station 7: **Field wash.** Thoroughly wash hands and face, and shower as soon as possible.

Equipment: Water
Wash basin/bucket
Soap
Paper towels

All residual soils, contaminated clothing, and decontamination solutions will be handled as hazardous waste until analytical data determines its actual status. All solid residuals will be double bagged, labeled, and remain on site for future disposal. Decontamination fluids will be containerized and transferred to the equipment decontamination station for disposal. All field personnel will keep the generation of residuals to a minimum.

8.3 Equipment Decontamination

Personal Protective Equipment

All personnel leaving the site must follow established decontamination procedures outlined in Section 8.2. All of the protective clothing for modified Level D and Level C is disposable and should be removed, double bagged, or placed in clearly marked drums and placed in secure. temporary storage as directed by the AFB for disposal after analytical results are received. If non-disposable clothing is used, it must be decontaminated with detergent and water before reuse. All decontamination solutions will be contained and either discharged at the equipment decontamination area to go through an oil-water separator or sampled and disposed off site. Respirators must be disinfected in accordance with the manufacturer's instructions and supplied disinfectant. Clothing worn on the site should be kept separated from other clothing until washed.

Equipment Decontamination

Decontamination of tools and equipment will be accomplished by a pressure wash and brushing as needed with detergent and potable water, followed by a water rinse. This method is in accordance with the Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells (EPA/600/4-89/034).

At the end of each day, all equipment must be decontaminated in a manner similar to personnel equipment before leaving the control zones. Richards-Gebaur AFB will provide a paved area where drilling equipment can be cleaned and decontaminated.

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations are ease of equipment decontamination or disposability. For example, soft-bristled scrub brushes or long-handle brushes are used to remove contaminants. Water in buckets or garden sprayers is used for rinsing. Large galvanized wash tubs or stock tanks can hold wash and rinse solutions. Large plastic garbage cans or other similar containers lined with plastic bags store contaminated clothing and equipment. Contaminated liquids can be stored temporarily in metal or plastic cans or drums. Other gear includes paper or cloth towels for drying protective clothing and equipment.

Effectiveness of Decontamination

There is no method to immediately determine how effective decontamination is in removing contaminants. Discolorations, stains, corrosive effects, and substances adhering to objects may indicate contaminants have not been removed. However, these observable effects only indicate surface contamination and not permeation (absorption) into clothing. Many contaminants are not easily observed; therefore, once decontamination procedures have been established, all personnel requiring decontamination must be given precise instructions (and practice if necessary). Compliance must be frequently checked.

Quality control measures typically include either equipment blank collection or wipe testing. Equipment blanks are samples of the final rinse water that are collected after cleaning the equipment. Equipment blanks should be collected in appropriate sampling containers, properly preserved, stored and transported to a laboratory for analyses of contaminants known or suspected at the site. Laboratory results provide "after the fact" information that may be used to evaluate whether or not the cleaning methods were effective in removing the contaminants of concern at the site. Discussion of the frequency and circumstances for collecting equipment blanks is discussed in the QAPP (Section C).

8.4 Clean Zone General Rules

- An area in the clean zone, outside the contamination reduction zone, will be designated as the break area. Employees will wash their face and hands before eating, drinking or smoking. No eating, drinking, or smoking will take place in the exclusion zone.

- An eyewash will be provided in the immediate work area for employees who may come into contact with contaminated materials.

- All entry to, and exit from, the clean zone to the exclusion zone will be through the contamination reduction zone and will be strictly controlled.

- o The PHSM and SHSO will monitor the effectiveness of the decontamination procedures and, if found ineffective, will take appropriate steps to correct any deficiencies or modify the plan if needed.

9.0 CONTINGENCY PLANNING

In accordance with 29 CFR 1910.120, this section has been developed to provide responses to emergencies that could reasonably be anticipated to occur at either of the sites at the Richards-Gebaur AFB during field activities.

9.1 Pre-Planning

Based on the information obtained during the previous activities, the site's location, and the planned activities, Tetra Tech considers the following events to be possible at the site:

- o Fire
- o Severe Weather
- o Spills or Releases
- o Injuries

The probability of the contingencies this plan covers actually occurring are considered low.

9.2 Fire

Probable Locations

Contaminant levels within and surrounding the Fire Valve Area are not expected to be of sufficient concentration to support combustion; however, refueling operations for any onsite equipment (i.e., drill rig) used for this investigation presents the potential for a fire.

Procedures

During drilling, well development, or purging, a PID or FID will be used to monitor ambient concentrations of volatile organics, particularly in the breathing zone. If an increasing concentration is detected, a combustible gas indicator (CGI) will be used to detect flammable situations. If the CGI detects 20 percent of the Lower Explosive Level (LEL) or more, all work will halt until vapor suppression techniques reduce the CGI readings. If vapor suppression is not effective, ignition sources will be secured or removed at least 50 feet off the borehole or well location. A fire extinguisher will be maintained in the immediate area during these type of operations. During onsite refueling, all ignition sources within 50 feet will be secured or removed, and a fire extinguisher will be readily available.

If these preventative measures fail and a fire results, the emergency signal specified in Section 9.6.1 will be sounded, and the notifications specified in Section 9.6.2 begun. The Task Manager/SHSO or onsite representative will assess the fire and determine if it is within the capability on hand to control. If it is the Task Manager/SHSO will direct the fire suppression efforts until the arrival of the Fire Department and arrange for the evacuation of any injured personnel. The SHSO or onsite representative will evacuate and account for all non-essential personnel from control zones, and the area of the fire. The SHSO will also establish an emergency aid station, if needed.

If the fire is not within onsite capability to control, the Task Manager/SHSO will withdraw all personnel from the area, bringing any injured persons with them until the arrival of the Fire Department. The SHSO will account for all personnel and then the non-essential personnel will be evacuated. Once personnel are withdrawn, no attempts to rescue trapped individuals will be allowed without appropriate protective equipment.

9.3 Severe Weather

Possible Types of Weather

High winds and severe thunderstorms may be encountered during the time frame of field activities at this site. Less common forms of weather will be handled in accordance with the most similar of the common forms. For example, a tornado warning would be handled in a manner similar to high winds. The occurrence of snow or ice storms is also probable during the scheduled timeframe for field investigations.

Effects of Severe Weather

The principal effect on the waste will be off site migration, either by wind-borne particulates or water-borne sediments. Personnel may be affected by reduced visibility, flying objects, particulates, and rapid temperature changes. Rain and rapid temperature changes could also adversely affect some survey instruments such as the PID. Snow and ice decrease dexterity, increase chances of slipping, and may cause mechanical problems.

Procedure

Weather forecasts should be monitored by the SHSO. When thunderstorms or winds in excess of 25 mph are forecast, all light weight equipment and personal gear not actually in use should be secured in such a manner as to prevent it from becoming a missile.

When severe thunderstorms, or winds in excess of 25 mph become imminent, the SHSO should consider whether activities not in a critical stage should cease. When lightning strikes in the vicinity, winds in excess of 40 mph (requiring an effort to walk erect) are encountered, or

visibility becomes severely curtailed, the SHSO will stop all operations, secure the site and direct personnel to leave the site or seek shelter. If there are lightning strikes in the immediate area, all activities will cease, and all personnel should seek shelter, somewhere other than trailers. If there are winds in excess of 50 mph all heavy equipment operations must stop and personnel should seek shelter, somewhere other than trailers. If there are winds in excess of 70 mph, all personnel should seek immediate shelter wherever they are.

If snow and/or ice begins to affect the operation of equipment, visibility, and the ability of personnel to perform their assigned jobs, the SHSO may stop work until conditions improve or if weather forecasts indicate the necessity to halt work for the day.

9.4 Spills and Releases

Probable Location

Spills or releases of hazardous materials and hazardous wastes are not likely to occur due to anticipated activities. Due to the nature of the majority of the contaminants, a hazardous release will likely be from soils so the actual contaminants will be fairly immobile. Under normal conditions, releases from soils are not a problem due to this lesser mobility. However, soils should be isolated by placing in a container and sealing to avoid contact with personnel.

Effects of Release or Spill

The effects of a release on the environment, personnel, and the surrounding community will depend on the material released. Of the known contaminants and their known concentration, no effects other than those originally prompting the sampling activity are anticipated. If an unknown pollutant is released, the hazards and corresponding risks will have to be assessed at the time of release, using the field survey instruments available (e.g., PID, etc.). The effects of a fuel spill will be minimal if the preventative measures described in Section 9.2 and this section are followed.

Procedures

During onsite refueling operations, the person performing the operation will have, on his person, the ignition keys to all vehicles involved to prevent inadvertent starting or pulling away during refueling. If the refueling hose is not equipped with an automatic back-pressure shut-off valve, a five gallon bucket will be placed under the refueling connection. When refueling is complete, the hose will be allowed to drain into one of the tanks. The valves at the connection points will be closed prior to disconnection or the hose end will be held higher than the liquid level in the fuel tank to preclude siphoning.

If a fuel spill does occur, it will be contained immediately using a small earthen dike established by a hand shovel. The contained liquid will then be cleaned up using a sorbent material. The sorbent and affected soil will be drummed and stored for disposal with the other wastes generated during site investigations. If a large spill beyond the capabilities of the refueling personnel occurs, the emergency signal specified in Section 9.6.1 will be sounded on a vehicle horn or portable air horn, and the notifications specified in Section 9.6.2 will be made.

9.5 Injuries

Injuries on site are significantly more likely to result from physical hazards than from chemical hazards. Heat stress becomes more likely in ambient temperatures over 70° F, but can occur below 70° F during hard physical work or while wearing protective equipment. Cold stress can occur at temperatures up to 50° F. Additional injuries that may occur include cuts, strains, and broken bones.

9.5.1 First Aid

First aid measures for cold stress are specified in Section 2.0. For other onsite injuries, at least one person with a valid American Red Cross First Aid certificate will be on site or readily available at all times. An emergency eyewash station and standard first aid kit will be available whenever personnel are on site.

In the event of acute exposure of personnel to toxic materials:

- **Skin contact** - use copious amounts of soap and water. Wash/rinse affected area for at least 15 minutes, decontaminate, then provide appropriate medical attention. An emergency eyewash and wash facilities will be provided on the site within the contamination reduction zone and/or the support zone.
- **Inhalation** - move to fresh air and, if necessary, decontaminate and notify the designated hospital (Research Belton Hospital).
- **Ingestion** - decontaminate/notify the designated hospital.
- The SHSO will attempt to secure the spread of contamination, if possible.
- Immediately notify the Project Manager.

9.5.2 Emergency Medical Treatment for Injuries Occurring in the Control Zone

Prior to the start of the sampling activity, the SHSO will notify the local emergency facility of the proposed activities and contaminants at the site, and will ensure that the facility is capable of handling contaminated patients.

If a person is injured, the emergency signal will be sounded as specified in Section 9.6.1. The SHSO or his onsite representative will immediately determine the cause of the injury, if possible. If it is not possible to determine the cause or if the cause is a chemical overexposure, the SHSO will order the evacuation of the personnel from the site, provided it has not already been accomplished. If the injured party can be moved without life-threatening harm, he will be brought to the decontamination station. If the injured person cannot be moved, the SHSO will dispatch a rescue team with appropriate equipment, bearing in mind the short duration of exposure. If appropriate gear is not available, rescue should not be attempted.

Once the injured person is brought to the decontamination station, or if the injury was not due to chemical overexposure, further movement of the injured person should be minimized until an assessment of the injury has been made. The SHSO, in consultation with emergency medical technicians (EMTs) if they are on site, or by phone with emergency room staff if not, should assess whether decontamination procedures should be instituted on site. For certain open wounds, such as in the chest cavity, normal decontamination procedures are not advisable. Generally, outer garments can be cut or gently torn off the individual. If there are no open wounds or on competent medical advice, decontamination procedures can be instituted. If decontamination is not instituted, all articles coming in contact with the injured person should be covered with an impervious, preferably disposable, material. This includes personnel and vehicles. Decontamination can then be undertaken under more controlled conditions at the hospital, preferably in an area which can be taken out-of-service without interrupting normal hospital service. A copy of the Site Safety Plan and/or the name of any suspected chemical contamination should be taken by the SHSO as he or she accompanies the injured person to the hospital. If necessary, medical treatment advice can be obtained from the Agency for Toxic Substance and Disease Registry (ATSDR) of the Centers for Disease Control (CDC), either through their headquarters in Atlanta, Georgia, or through the U.S. EPA Regional Office. The Project Manager can access corporate resources to advise the doctor if desired. If EMTs are called to the site, they should be met at the boundary to the site and escorted to the SHSO.

9.6 General Contingency Procedures

9.6.1 Recognition and Alert/Emergency Signal

All personnel on site must remain alert to their surroundings at all times. If abnormal or unexpected actions are noted by anyone, the observer will immediately alert the Task Manager or her onsite designee. Emergency alert communication on site will consist of an audible alarm

system. An air horn provided for that purpose, or the horn in the nearest vehicle will employ the following sequences:

- o Fire - One short blast every five (5) seconds
- o Medical Emergency - Two sequential short blasts repeated every five seconds
- o Evacuation - One long blast repeated every five (5) seconds
- o Test - One short blast only.

9.6.2 Personnel Roles

The SHSO, upon notification of an abnormal event or upon hearing the emergency signal, will immediately proceed to a safe observation post and rapidly assess the situation. He or she will direct either the evacuation of the control zone or the entry of additional support personnel and equipment, depending on the nature of the event. The Task Manager will then directly, or through a specified individual, notify the U.S. Air Force by the most expeditious means. The U.S. Air Force may elect to notify the appropriate authorities, and the Task Manager will arrange for the most expeditious notification the situation requires. After the authorities have been notified, the Project Manager will be notified. After arranging for these notifications, the Project Manager will direct the activities of all site personnel in any mitigative efforts deemed necessary by this plan, the U.S. Air Force, Tetra Tech corporate management, or his own initiative. The Task Manager will meet the various local and state authorities as they arrive, if the SHSO is otherwise engaged.

The SHSO, will supervise the evacuation of the site and will account for all individuals on site, including visitors. The SHSO will use the tailgate safety meeting form to account for site workers and visitors/observers. The SHSO will advise responding authorities on the hazards and precautionary measures to avoid overexposure and brief them on the factual, known events from initiation of the crisis to their arrival.

Unless specifically authorized by the U.S. Air Force, the SHSO will not allow the media past the site boundaries, or to speak to any site personnel except himself and the Task Manager. A brief statement of facts to the media may be allowed, but all direct inquiries into the events must be referred to the U.S. Air Force or the local authorities, as appropriate. Otherwise, the SHSO will advise and assist the Task Manager.

The Project Manager will, upon notification from the site, mobilize corporate resources as necessary to support the activities on site. This support will be coordinated through the U.S. Air Force and the Task Manager to avoid duplication of efforts.

Any subcontractor site manager on site will implement the directions of the Task Manager. While Tetra Tech recognizes the right of a subcontractor to protect its employees as it deems best, it is vital that all actions be coordinated by the Task Manager. Consequently, no

subcontractor will be allowed to take independent action without notifying the Task Manager, unless a readily apparent, immediate threat to their personnel exists.

9.6.3 Site Control

If an abnormal event occurs, the area of local impact and the site will be isolated to the maximum extent possible. Any visitors to the site will be evacuated and/or escorted away from the event. Upon hearing the emergency signal, all personnel not directly involved will stop their actions and report to the SHSO for direction. If directed by the SHSO, the control zones will be evacuated.

9.6.4 Site Evacuation

In the event that the SHSO elects to evacuate the site, the evacuation will continue until normal conditions have been restored and re-entry is authorized by the task manager and/or SHSO. The SHSO will make site personnel aware of evacuation routes (primary and alternate). Evacuation will be upwind or crosswind from any toxic or hazardous airborne contaminant. On a daily basis, the SHSO will determine a central meeting point based on the locations of the current work zones. The evacuation rendezvous point will be discussed daily with the site workers. A daily head count will be made by the SHSO to determine, should evacuation become necessary, if all site personnel are safely evacuated.

9.6.5 Post-Incident Critique

After an emergency event has occurred and has been dealt with, the SHSO will request a de-briefing involving all concerned individuals and all personnel on site at the time of the event. The de-briefing will be held as soon as possible after the event. The following topics, at a minimum, should be discussed:

- What happened to cause the incident?
- What went well in the execution of this plan?
- What went wrong with this plan?
- What can be done to correct the effects?
- What can be done to prevent a recurrence?

Within seven workdays, the SHSO will prepare a report outlining the cause and effect of the event and the opinions voiced in the de-briefing. This report will be submitted to the Project Manager for approval. The Task Manager will supervise the implementation of any preventative recommendations while the SHSO will oversee any remedial actions deemed necessary. If the event involved an injury only, the incident report required by Tetra Tech's Health and Safety Program will be completed.

9.7 Emergency Notification List

LOCAL/SITE RESOURCES

Hospital

Research Belton Hospital 17065 South U.S. 71 Belton, MO. Directions are outlined on the emergency route map (Figure D-3)	(816) 348-1200

Emergency Transportation Systems (Fire, Police, Ambulance)

Grandview Fire	911
Grandview Police	911
Belton Fire	(816) 331-2121
Belton Police	(816) 331-1500

Tetra Tech

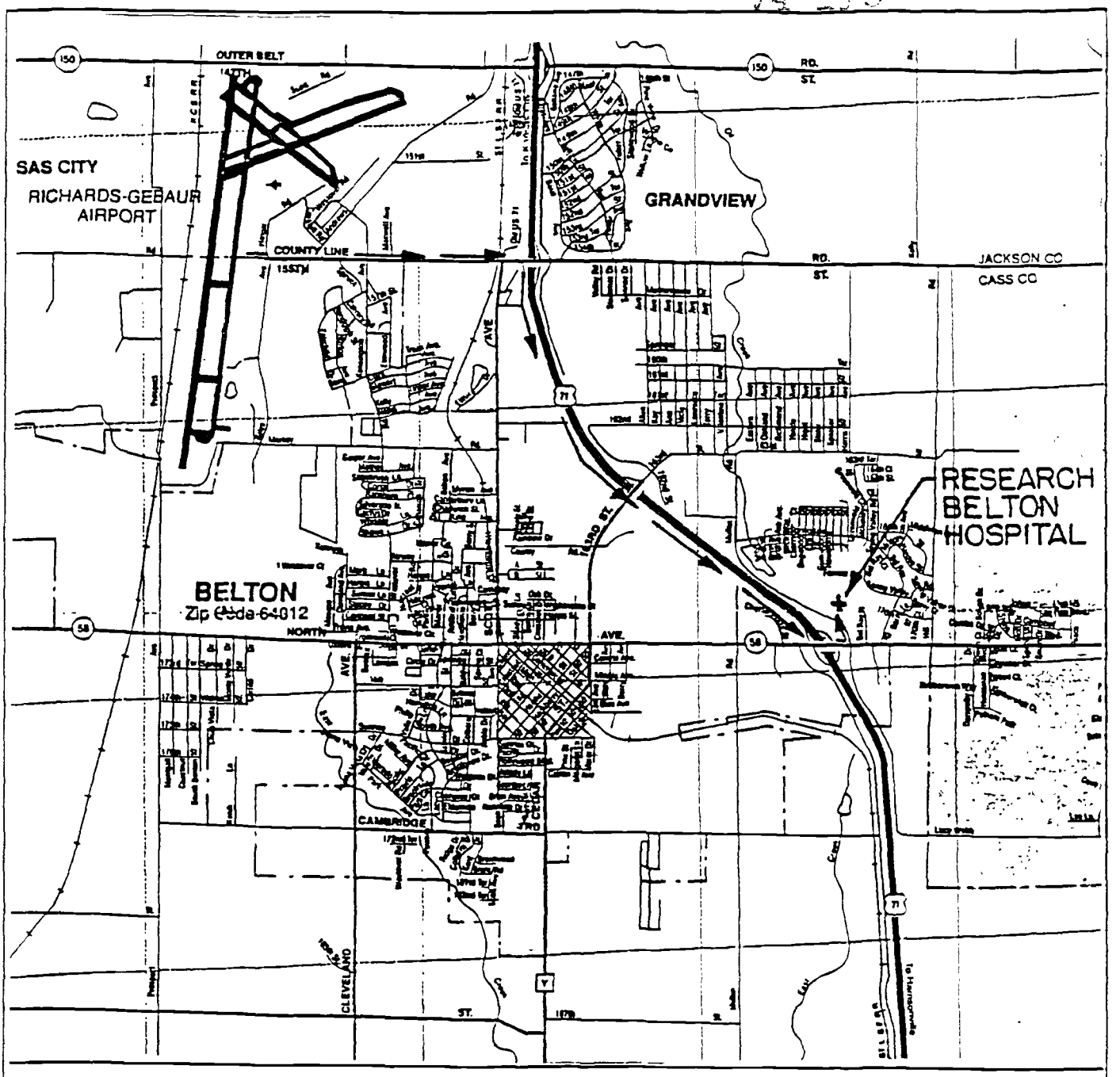
Project Manager; Russ Krohn	Work (913) 621-6041 Home (816) 228-1512
Regional CIH; John King	Work (415) 974-1221
Project Health and Safety Officer; Pam McKee	Work (913) 621-6041 Home (816) 741-3559
Task Manager/SHSO, PA/SI SS009; Julie WestHoff	Work (913) 621-6041 Home (913) 681-5003
Task Manager/SHSO, Drainage Pond; Pam McKee	Work (913) 621-6041 Home (816) 741-3559

Richards-Gebaur AFB

Fire	117
Police	2200

Other Resources

U.S. EPA Spill Line - Region VII	(913) 236-3778
U.S. EPA Superfund/RCRA Hotline	(800) 424-9346
National Response Center	(800) 424-8802
ATSDR	Day (404) 639-3111 Night (404) 329-2889
CHEMTREC (24 hr/day)	(800) 424-9300



RESEARCH BELTON HOSPITAL
17065 SOUTH U.S. 71, BELTON, MO.
(816) 348-1200

Leave Richards-Gebaur AFB by 155th Street heading east to U.S. 71, continue south on U.S. 71 to North Ave. , exit U.S. 71 and turn left (east) on North Ave. continue under U.S. 71 and turn left (north) onto outer road.

FIGURE D-3
LOCATION AND ROUTE TO AREA HOSPITAL

References:

Corporate Health and Safety Program Manual: Tetra Tech, Inc. Revised February 18, 1992.

Worker Protection During Hazardous Waste Remediation: The Center for Labor Education and Research.

Standard Operating Safety Guides: Environmental Response Branch, Hazardous Response Support Division, Office of Emergency and Remedial Response, U.S. EPA. November, 1984.

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities: NIOSH/OSHA/USCG/EPA. October, 1985.

Health and Safety Audit Guidelines; SARA Title I, Section 126: Office of Emergency and Remedial Response, Emergency Response Division, U.S. EPA. December 1989.

Field Standard Operating Procedures (FSOP) #7; Decontamination of Response Personnel: Office of Emergency and Remedial Response, Hazardous Response Support Division. January 1985.

APPENDICES

APPENDIX D-1

SITE SAFETY PLAN CONSENT AGREEMENT

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TETRA TECH. INC.
SITE SAFETY PLAN CONSENT AGREEMENT

I have reviewed the Tetra Tech. Inc. Health and Safety Plan for the Assessment of the Drainage Pond at Richards-Gebaur Air Force Base. I understand its purpose and consent to adhere to its policies, procedures, and guidelines while an employee, or subcontractor, of Tetra Tech.

Employee Signature	Date
Employee Signature	Date
Employee Signature	Date
Employee Signature	Date
Employee Signature	Date
Employee Signature	Date
Employee Signature	Date

Copies of this page, with signatures of all field personnel, will be submitted to the Project Manager (Russell B. Krohn) and the Tetra Tech Health and Safety Officer (Pamela L. McKee).

APPENDIX D-2

IRP TOXICOLOGY GUIDES

CHEMICAL COMPOSITION:

Approximate Composition:

Alkanes	61.0%
Cycloalkanes	29.0%
Alkylbenzenes	8.0%
Indans/tetralins	1.1%
Naphthalenes	0.0% <1%

REACTIVITY	Various sources typically report that hydrocarbon mixtures are incompatible with strong acids, alkalis, and strong oxidizers such as liquid chlorine and oxygen. The NFPA reports vigorous reactions, ignition, or explosions involving chlorine, fluorine, or magnesium perchlorate. Jet fuels are considered to be miscellaneous combustible or flammable materials for compatibility classification purposes. Such substances typically evolve heat, fire, and toxic or flammable gases in reactions with oxidizing mineral acids, organic peroxides or hydroperoxides, or strong oxidizing agents.(505,507,511).

PHYSICO-CHEMICAL DATA	• Physical State: Liquid (at 20°C)	(60)
	• Color: Colorless to light brown	(60)
	• Odor: Fuel-oil	(60)
	• Odor Threshold: 1 ppm	(60)
	• Density: 0.7500 g/mL (at 20°C)	(1934)
	• Freeze/Melt Point: -72.00°C	(1933)
	• Boiling Point: 60.00 to 270.00°C	(1933)
	• Flash Point: -23.00 to -1.00°C closed cup; -29°C	(23.51.60.1934)
	• Flammable Limits: 1.30 to 8.00% by volume	(60.506)
	• Autoignition Temp.: 240.0 to 242.0°C	(23.51.60.506)
	• Vapor Pressure: 9.10E+01 mm Hg (at 20°)	(1934)

PHYSICO-CHEMICAL DATA (Cont.)	Satd. Conc. in Air: 6.6000E+05 mg/m^3 (at 20°C)	(ADL estim)
	• Solubility in Water: 300 mg/L (at 20°C)	(2251)
	• Viscosity: 0.829 cp (at 21°C)	(60)
	• Surface Tension: 2.5000E+01 dyne/cm (estim) (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.00 to 7.00. Range for typical components	(See Table 64-4)
	• Soil Adsorp. Coeff.: 2.40E+02 to 5.00E+06 (range for typical components)	(See Table 64-4)
	• Henry's Law Const.: 1.00E-04 to 1.00E+01 $atm \cdot m^3/mol$. Range for typical components	(See Table 64-4).
	• Bioconc. Factor: 5.00E+01 to 5.00E+05 (range for typical components)	(ADL estim)

PERSISTENCE IN THE SOIL-WATER SYSTEM	JP-4 hydrocarbons are expected to be relatively mobile and non-persistent in most soil systems. Persistence in deep soils and groundwater may be higher. Volatilization, photooxidation and biodegradation are important fate processes. Surface spills are expected to be weathered by evaporation and photooxidation. Downward migration of weathered JP-4 surface spills and sub-surface discharges represent a potential threat to underlying groundwater. Biodegradation of JP-4 hydrocarbons is expected to be significant under environmental conditions favorable to microbial oxidation; naturally-occcurring, hydrocarbon-degrading microorganisms have been isolated from polluted soils and, to a lesser extent, non-polluted soils.

PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/groundwater system is the contamination of groundwater drinking water supplies by JP-4 from leaking storage tanks or large spills. Vapors from leaked or spilled fuel may diffuse through soils and migrate into structures, resulting in inhalation exposures. Inhalation exposure may also occur from the direct volatilization of spills, and in some instances, aircraft fuel jettisoning may result in the contamination of surface water and agricultural land, leading to ingestion with water or food.

HEALTH HAZARD DATA	Signs and Symptoms of Short-term Human Exposure. (60, 1932) Short-term exposure to high vapor levels can cause irritation of the respiratory tract, headaches, nausea, and mental confusion. In extreme cases, loss of consciousness can occur. Ingestion is irritating to the stomach. Aspiration of the liquid into the lungs can give rise to chemical pneumonitis. The liquid may cause defatting, drying and irritation of the skin. Both the vapor and the liquid are irritating to the eyes. Acute Toxicity Studies: ORAL: No Data SKIN: No data INHALATION: No data Long-Term Effects: Liver and kidney damage (animal), neurological damage (human) Pregnancy/Neonate Data: No data Genotoxicity Data: Limited data are negative Carcinogenicity Classification: IARC - No data NTP - No data EPA - No data

HANDLING PRECAUTIONS (1967)	No specific respirator guidelines were found for JP-4. The following guidelines are for kerosene with a boiling range of 175-325°C • Less than or equal to 1000 mg/m^3: chemical cartridge respirator with half-mask facepiece and organic vapor cartridge or supplied-air respirator with half-mask facepiece operated in demand mode • 1000-5000 mg/m^3: gas mask with full facepiece and organic canister; supplied- air respirator with full facepiece or self-contained breathing apparatus with full facepiece operated in demand mode • Appropriate protective clothing including gloves, aprons and boots • Chemical goggles if there is probability of eye contact.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards

- OSHA TWA (8-hr): petroleum distillates (naphtha) 400 ppm
- AFOSH PEL (8-hr TWA): petroleum distillates (naphtha) 400 ppm; STEL (15-min): 500 ppm

Criteria

- NIOSH IDLH (30-min): petroleum distillates (naphtha) - 10,000 ppm; gasoline - none established
- ACGIH TLV® (8-hr TWA): petroleum distillates (naphtha) - none established; gasoline - 300 ppm
- ACGIH STEL (15-min): petroleum distillates (naphtha) - none established; gasoline - 500 ppm

COMMON SYNONYMS:	CAS REG NO. NIOSH NO.:	CHEMICAL COMPOSITION
Automotive gasoline Benzin Motor spirits Petrol	8006-61-9 LX3300000 MOLECULAR WEIGHT: Not applicable Air W/V Conversion: (25°C) 4.5 mg/m^3 = 1 ppm 0.222 ppm = 1 mg/m^3	Approximate Composition N-alkanes 15.0% - 17.0% Cycloalkanes 3.0% - 5.0% Benzenes and Alkylbenzenes 20.0% - 49.0% Branched alkanes 28.0% - 36.0% Olefins 1.0% - 11.0% Naphthalenes 0.0% - ≤1.0%

REACTIVITY	Several sources indicate that strong oxidizers are incompatible with gasoline and that vigorous reactions ignition, and/or explosion may be expected. The NFPA specifically notes such events when chlorine, fluorine, or magnesium perchlorate are mixed with hydrocarbons. Gasoline is considered a miscellaneous combustible or flammable material for compatibility classification purposes. Such substances typically evolve heat, fire, and toxic or flammable gases in reactions with oxidizing mineral acids, alkali or alkaline earth elemental metals, nitrides, organic peroxides or hydroperoxides, or strong oxidizing agents. Reactions with explosive materials may result in an explosion, while those with strong reducing agents may evolve heat and flammable gases. Non-oxidizing mineral acids generally evolve heat and innocuous gases. High fire hazard and moderate explosion hazard when exposed to heat, flame, sparks, etc (51, 505, 507, 511).

PHYSICO-CHEMICAL DATA	• Physical State: Liquid (at 20°C)	(60)
	• Color: Colorless to pale brown or pink	(60)
	• Odor: Characteristic	(54,60)
	• Odor Threshold: 0.250 ppm	(60)
	• Density: 0.7321 g/mL (at 20°C)	(60)
	• Freeze/Melt Point: No data	(60)
	• Boiling Point: 38.00 to 204.00°C	(39,60)
	• Flash Point: -46.00 to 38.00°C closed cup, depending on grade	(60,506,507)

PHYSICO-CHEMICAL DATA	Flammable Limits: 1.2-1.50 to 7.1-7.60% by volume, depending on grade	(60,504, 506,507)
	• Autoignition Temp.: 257.0 to 471.0°C (varies with grade)	(51,60 510,513,507)
	• Vapor Pressure: 2.63E+02 to 6.75E+02 mm Hg (at 38°C)	(1932)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: Insoluble	(60)
	• Viscosity: 0.451 cp (at 20°C)	(60)
	• Surface Tension: 1.9000E+01 to 2.3000E+01 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 2.13 to 4.87	(See Table 65-3)
	• Soil Adsorp. Coeff.: 6.50E+01 to 3.60E+04	(See Table 65-3)
	• Henry's Law Const.: 4.80E-04 to 3.30E+00 atm · m^3/mol (at 20°C)	(See Table 65-3)
	• Bioconc. Factor: No data	

PERSISTENCE IN THE SOIL-WATER SYSTEM	Gasoline hydrocarbons are expected to be relatively mobile and moderately persistent in most soil systems. Persistence in deep soils and groundwater may be higher. Volatilization, photooxidation and biodegradation are important fate processes. Surface spills are expected to be weathered by evaporation and photooxidation. Downward migration of weathered surface spills and sub-surface discharges represent a potential threat to underlying groundwater. Biodegradation of gasoline hydrocarbons is expected to be significant under environmental conditions favorable to microbial oxidation; naturally-occurring, hydrocarbon-degrading microorganisms have been isolated from polluted soils and, to a lesser extent, non-polluted soils.

PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/ground-water system is the migration of gasoline to ground water drinking water supplies from leaking underground storage tanks or large spills. The use of this water may cause inhalation exposures as well as ingestion and dermal exposures. Vapors from leaked or spilled gasoline may diffuse through soil and migrate into structures, resulting in inhalation exposures.

HEALTH HAZARD DATA

Signs and Symptoms of Short-term Human Exposure: (54)

Gasoline vapor is a CNS depressant. Low vapor levels (500-1000 ppm) may produce flushing, staggering gait, slurred speech and mental confusion. High vapor levels (>5000 ppm) may cause coma and death from respiratory failure. Ingestion and aspiration may cause chemical pneumonitis, pulmonary edema and hemorrhage, and kidney damage. Gasoline is irritating to the skin, conjunctiva and mucous membranes Prolonged contact may defat skin and cause dermatitis. Certain individuals may develop hypersensitivity.

Acute Toxicity Studies:

INHALATION:

LC_{Lo}	135,000 mg/m^3 · 5 min	Mammal (51)
TC_{Lo}	2,250-4,500 mg/m^3 · 30-60 min (Neurotoxicity)	Human (3504)
LC_{Lo}	22,500 mg/m^3 (5000 ppm)	Human (3504)
LC_{50}	300,000 mg/m^3 · 5 min	Mouse (3504)
LC_{50}	300,000 mg/m^3 · 5 min	Guinea pig (3504)
LC_{50}	300,000 mg/m^3 · 5 min	Rat (3504)
TC_{Lo}	900 ppm · 1 hr (eye irritation)	Human (3504)

ORAL:

LD_{50}	13,600 mg/kg	Rat (1924)

Long-Term Effects: Chronic inhalation produces pulmonary changes and kidney damage, lead toxicity with leaded gas.

Pregnancy/Neonate Data: Negative

Genotoxicity Data: Limited data are conflicting

Carcinogenicity Classification:

IARC - None assigned
NTP - None assigned
EPA - Group B2 (probable human carcinogen, sufficient evidence in animals and inadequate evidence in humans)

HANDLING PRECAUTIONS (45,52)	Handle only with adequate ventilation. There are no specific respirator guidelines for gasolines. • Chemical goggles if there is probability of eye contact • Nitrile, PVA or other protective clothing to prevent prolonged or repeated skin contact with the liquid.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards
- OSHA TWA (8-hr): 300 ppm; STEL (15-min): 500 ppm
- AFOSH (8-hr TWA): 300 ppm; STEL (15-min): 500 ppm

Criteria
- NIOSH IDLH (30-min): None established
- NIOSH REL: None established
- ACGIH TLV® (8-hr TWA): 300 ppm
- ACGIH STEL (15-min): 500 ppm

WATER EXPOSURE LIMITS:

Drinking Water Standards
None established.

EPA Health Advisories and Cancer Risk Levels
None established.

WHO Drinking Water Guideline
No information available.

EPA Ambient Water Quality Criteria
- Human Health (355)
  - No criterion established; automotive gasoline is not a priority pollutant.

COMMON SYNONYMS:	CAS REG. NO.	NIOSH NO.
Fuel Oil No.: 1*	8008-20-6	OA5500000
Coal oil		
Fuel oil no. 1		
JP-1		
Kerosene		
Range oil		
Fuel Oil No.: 1-D*		
Diesel oil (light)		
Fuel oil 1-D		
Fuel Oil No.: 2*	68476-30-2	HZ1800000
Diesel oil		
Fuel oil no. 2		
Home heating oil		
Fuel Oil No.: 2-D*		
Diesel oil (medium)		
Fuel oil 2-D		
Fuel Oil No.: 4*	68476-31-3	
Fuel oil no. 4		
Residual fuel oil no. 4		
Fuel Oil No.: 5*		
Fuel oil no. 5		
Navy special fuel oil		
Residual fuel oil no. 5		
Fuel Oil No.: 6*	68553-00-4	
Bunker c oil		
Fuel oil no. 6		
Residual fuel oil no. 6		
Fuel Oil No.: UNSP**		LS8950000
Fuel oil		

CHEMICAL COMPOSITION:

*The composition given in the record is for generic "FUEL OIL"

**Olefinic hydrocarbons 1.0% - 2.0%
Aromatic hydrocarbons 35.0%
Aliphatic hydrocarbons 64.0%

PHYSICO-CHEMICAL DATA (Fuel Oil No. 1)	Physical State: Liquid (at 20°C)	(60)
	• Color: Colorless to brown	(60)
	• Odor: Kerosene-like	(60)
	• Odor Threshold: No data	
	• Density: 0.8100 to 0.9360 g/mL (at 15°C)(range for 1,4,5, and 1D)	(60)
	• Freeze/Melt Point: -48 to 18°C	(60)
	• Boiling Point: 151 to >588°C	
	• Flash Point: 38.00 to 74.00°C for various grades of fuel oil No.1	(12,51,60, 504,506,507)
	• Flammable Limits: 0.6-1.3% to 5.0 to 7.50% for fuel oils 1-5	(51,60,501, 506)
	• Autoignition Temp.: 177.0 to 329.0°C depending on grade for fuel oils 1-5	(51,60,506, 507,513)
	• Vapor Pressure: 2.12-26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(2297)
	• Viscosity: 1.152 to 1.965 cp (at 21°C)	(60)
	• Surface Tension: 21-32 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.3-7.06	(See Table 66-3)
	• Soil Adsorp. Coeff.: 9.6E+02 to 5.5E+06	(See Table 66-3)
	• Henry's Law Const.: 5.9E-05 to 7.4 atm · m^3/mol (at 20°C)	(See Table 66-3)
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil No. 1-D)	• Physical State: Liquid (at 20°C)	(60
	• Color: Colorless to brown	(60
	• Odor: Kerosene-like	(60
	• Odor Threshold: No data	
	• Density: 0.8100 to 0.9360 g/mL (at 15°C)	(60)
	• Freeze/Melt Point: -48 to 18°C	(60)
	• Boiling Point: 151 to >588°C	(60)
	• Flash Point: Ranges from 38-74°C	(12,51,60,504, 506,507
	• Flammable Limits: 0.6 to 7.5%	(51,60,506,507
	• Autoignition Temp.: 177.0 to 329.0°C depending on grade for fuel oil No. 1-5	(51,60,506, 507,513)
	• Vapor Pressure: 2.12 to 26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(229
	• Viscosity: 1.152 to 1.965 cp (at 21°C)	(60
	• Surface Tension: 21 to 32 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.3 to 7.06	(See Table 66-3
	• Soil Adsorp. Coeff.: 9.6E+02 to 5.5E+06	(See Table 66-3
	• Henry's Law Const.: 5.9E-05 to 7.4	(See Table 66-3
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil No.2)	Physical State: Liquid (at 20°C)	(60)
	Color: Colorless to brown	(60)
	• Odor: Kerosene-like	(60)
	• Odor Threshold: No data	(60)
	• Density: 0.8700 to 0.9500 g/mL (at 20°C)	(60)
	• Freeze/Melt Point: -48 to 18°C	(60)
	• Boiling Point: 151 to >588°C	(60)
	• Flash Point: Ranges from 38-74°C for various grades of fuel oil No. 1 to 69-169°C for grades of fuel oil No. 5	(504,506,507)
	• Flammable Limits: 0.60 to 7.50% by volume	(51,60,506,507)
	• Autoignition Temp.: 177.0 to 329.0°C depending on grade for fuel oils 1-5	(51,60,506, 507,514)
	• Vapor Pressure: 2.12 to 26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(2297)
	• Viscosity: 1.152 to 1.965 cp (at 21°C)	(60)
	• Surface Tension: 21-32 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.3 to 7.06	(See Table 66-3)
	• Soil Adsorp. Coeff.: 9.6E+02 to 5.5E+06	(See Table 66-3)
	• Henry's Law Const.: 5.9E-05 to 7.4	(See Table 66-3)
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil No. 2-D)	Physical State: Liquid (at 20°C)	(60)
	• Color: Colorless to brown	(60)
	• Odor: Kerosene-like	(60)
	• Odor Threshold: No data	
	• Density: 0.870 to 0.950 g/mL (at 20°C)	(60)
	• Freeze/Melt Point: -48 to 18°C	(60)
	• Boiling Point: 151 to >588°C	(60)
	• Flash Point: Ranges from 38-74°C for various grades of fuel oil No. 1 to 69-169°C for grades of fuel oil No. 5	(12,51,60,504, 506,507)
	• Flammable Limits: 0.6 to 7.5%	(51,60,506,507)
	• Autoignition Temp.: 177.0 to 329.0°C depending on grade for fuel oil No. 1-5	(51,60,506, 507,513)
	• Vapor Pressure: 2.12 to 26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No Data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(229)
	• Viscosity: 1.152 to 1.965 cp (at 21°C)	(60)
	• Surface Tension: 21 to 32 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.3 to 7.06	(See Table 66-3)
	• Soil Adsorp. Coeff.: 9.62E+02 to 5.5E+05	(See Table 66-3)
	• Henry's Law Const.: 5.9E-05 to 7.4	(See Table 66-3)
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil No.4)	Physical State: Liquid (at 20°C)	(60)
	Color: Colorless to brown	(60)
	Odor: Kerosene-like	(60)
	• Odor Threshold: No data	(60)
	• Density: 0.810 to 0.9360 g/mL (at 15°C)	(60)
	• Freeze/Melt Point: -48 to 18°C	(60)
	• Boiling Point: 151 to >588°C	(60)
	• Flash Point: Ranges from 38-74°C for various grades of fuel oil No. 1 to 69-169°C for grades of fuel oil No. 5	(12,51,60, 504, 506)
	• Flammable Limits: 0.60-1.3 to 5.0-7.5 % by volume, for fuel oils No. 1-5	(51,60,506, 507)
	• Autoignition Temp.: 177.0 to 329.0°C depending on grade for fuel oil No. 1-5	(51,60, 506 507, 573)
	• Vapor Pressure: 2.12 to 26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(2297)
	• Viscosity: 14.50 to 493.50 cp (at 38°C)	(60)
	• Surface Tension: 21-32 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.3 to 7.06	(See Table 66-3)
	• Soil Adsorp. Coeff.: 9.62E+02 to 5.5E+06	(See Table 66-3)
	• Henry's Law Const.: 5.9E-05 to 7.4	(See Table 66-3)
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil No. 5)	Physical State: Liquid (at 20°C)	(60
	• Color: Colorless to brown	(60
	• Odor: Kerosene-like	(60
	• Odor Threshold: No data	
	• Density: 0.8100 to 0.9360 g/mL (at 15°C)	(60
	• Freeze/Melt Point: -48 to 18°C	(60
	• Boiling Point: 151 to >588°C	
	• Flash Point: Ranges from 69-169°C for various grades of fuel oil No. 5	(504,506,507)
	• Flammable Limits: 0.6-1.3 to 5.0-7.5% by volume for fuel oils No. 1-5	(51,60,506, 507)
	• Autoignition Temp.: 177.0 to 329.0°C for fuel oil No. 1-5	(51,60,506, 507,513)
	• Vapor Pressure: 2.12 to 26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(229
	• Viscosity: 14.50 to 493.5 cp (at 21°C)	(60)
	• Surface Tension: 21-32 dyne/cm (at 20°C)	(See Table 66-3
	• Log (Octanol-Water Partition Coeff.): 3.3 to 7.06	(See Table 66-3
	• Soil Adsorp. Coeff.: 9.62E+02 to 5.5E+06	(See Table 66-3
	• Henry's Law Const.: 5.9E-05 to 7.4	(See Table 66-3
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil No.6)	Physical State: Liquid (at 20°C)	(60)
	• Color: Colorless to brown	(60)
	• Odor: Kerosene-like	(60)
	• Odor Threshold: No data	
	• Density: 0.8700 to 0.9500 g/mL (at 20°C)	(60)
	• Freeze/Melt Point: -48 to 18°C	(60)
	• Boiling Point: 151 to >588°C	(60)
	• Flash Point: No data	
	• Flammable Limits: No data	
	• Autoignition Temp.: No data	
	• Vapor Pressure: 2.12 to 26.4 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: No data	
	• Solubility in Water: ~5 mg/L (at 20°C)	(2297)
	• Viscosity: 14.50 to 493.50 cp (at 38°C)	(60)
	• Surface Tension: 21-32 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.3 to 7.06	(See Table 66-3)
	• Soil Adsorp. Coeff.: 9.62E-02 to 5.5E+06	(See Table 66-3)
	• Henry's Law Const.: 5.9E-05 to 7.4	(See Table 66-3)
	• Bioconc. Factor: No data	

PHYSICO-CHEMICAL DATA (Fuel Oil UNSP)	• Physical State: Liquid (at 20°C)	(60
	• Color: Colorless to brown	(60
	• Odor: Characteristic kerosene-like	(60
	• Odor Threshold: No data	
	• Density: No data	(60)
	• Freeze/Melt Point: -48.0 to 18.0°C	(60)
	• Boiling Point: 151.00 to >588.00°C	(60)
	• Flash Point: No data	(12,51,60, 504,506,507
	• Flammable Limits: No data	(51,60,506, 507
	• Autoignition Temp.: No data	(51,60,506 50,513)
	• Vapor Pressure: 2.12E+00 to 2.64E+01 mm Hg (at 21°C)	(60)
	• Satd. Conc. in Air: Not available	
	• Solubility in Water: ~5 mg/L (at 20°C)	(229
	• Viscosity:	(60)
	• Surface Tension: 2.100E+01 to 3.200E+01 dyne/cm (at 20°C)	(60)
	• Log (Octanol-Water Partition Coeff.): 3.30 to 7.06	(See Table 66-3
	• Soil Adsorp. Coeff.: 9.62E+02 to 5.50E+06	(See Table 66-3
	• Henry's Law Const.: 5.90E-05 to 7.40 atm · m^3/mol (at 20°C)	(See Table 66-3
	• Bioconc. Factor: Not available	

REACTIVITY	Various sources typically report that fuel ils are incompatible with strong oxidizers such as liquid chlorine and oxygen. The NFPA reports vigorous reactions, ignition, or explosions involving chlorine, fluorine, or magnesium perchlorate. Fuel oils are considered to be miscellaneous combustible or flammable materials for compatibility classification purposes. Such substances typically evolve heat, fire, and toxic or flammable gases in reactions with oxidizing mineral acids, organic peroxides or hydroperoxides, or strong oxidizing agents. Reactions with explosive materials may result in an explosion. (505, 507, 511).
PERSISTENCE IN THE SOIL-WATER SYSTEM	Diesel oil hydrocarbons are expected to have moderate mobility and moderate persistence in most surface soils; persistence in deep soils and groundwater may be higher. Volatilization, sorption, photooxidation, and biodegradation are all potential fate processes. Surface spills may be weathered to a limited extent by evaporation; downward migration of weathered surface spills and sub-surface discharges represent a potential threat to underlying groundwater. Biodegradation of fuel oil hydrocarbons is expected to occur under environmental conditions favorable to microbial oxidation; naturally-occurring, hydrocarbon-degrading microorganisms have been isolated from polluted soils and, to a lesser extent, non-polluted soils. The hydrocarbons of residual fuel oils are expected to be less mobile (lower aqueous solubility, higher sorption and lower volatility) and more persistent (slower biodegradation) than the lighter diesel oil hydrocarbons.
PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/groundwater system is the migration of fuel oils to ground water drinking water supplies from leaking underground storage tanks or large spills. Vapors from leaked or spilled fuels may diffuse through soil and migrate into structures resulting in inhalation exposures.

HEALTH HAZARD DATA	Signs and Symptoms of Short-term Human Exposure: (17, 54) The primary systemic effect is CNS depression. Inhalation of high concentrations mat cause headache, nausea, confusion, drowsiness, convulsions and coma. Ingestion may cause nausea, vomiting and in severe cases, drowsiness progressing to coma. Aspiration may cause extensive pulmonary injury. The liquid may produce primary skin irritation. Dermal absorption may induce nephropathy. Minimal eye injury from direct contact. Acute Toxicity Studies: ORAL: LD_{50} 5.1-20 g/kg Rat (1924) Long-Term Effects: Kidney damage (animals); CNS depression and dermatoses (humans) Pregnancy/Neonate Data: Negative Genotoxicity Data: Limited evidence Carcinogenicity Classification: IARC - None assigned NTP - Equivocal evidence for carcinogenicity of marine diesel fuel in $B6C3F_1$ mice. EPA - No data
HANDLING PRECAUTIONS (1967)	No specific respirator guidelines were found for fuel oils. The following guidelines are for kerosene with a boiling range of 175-325°C • Less than or equal to 1000 mg/m^3: chemical cartridge respirator with half-mask facepiece and organic vapor cartridge or supplied air respirator with half-mask facepiece operated in demand mode • 1000-5000 mg/m^3: gas mask with full facepiece and organic canister, supplied-air respirator with full facepiece or self-contained breathing apparatus with full facepiece operated in demand mode • Appropriate protective clothing including gloves, aprons and boots • Chemical goggles if there is probability of eye contact.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards

- OSHA TWA (8-hr): petroleum distillates (naphtha)-400 ppm
- AFOSH PEL (8-hr TWA): petroleum distillates (naphtha)-400 ppm; STEL (15-min): 500 ppm

Criteria

- NIOSH IDLH (30-min): petroleum distillates (naphtha)-10,000 ppm
- NIOSH REL TWA (10-hr): petroleum distillates (naphtha)-350 mg/m^3
- NIOSH CL (15-min): petrolium distillates (naphtha)-1800 mg/m^3
- ACGIH TLV® (8-hr TWA): petroleum distillates (naphtha)-none established
- ACGIH STEL (15-min TWA): petroleum distillates (naphtha)-none established

WATER EXPOSURE LIMITS:

Drinking Water Standards

None established

EPA Health Advisories and Cancer Risk Levels

None established

WHO Drinking Water Guideline

No information available.

EPA Ambient Water Quality Criteria

- Human Health (355)
  - No criterion established; fuel oils are not a priority pollutant.
- Aquatic Life (355)
  - No criterion established; fuel oils are not a priority pollutant.

REFERENCE DOSES:

No reference dose available.

Oil and Grease (2012)

For domestic water supply: Virtually free from oil and grease, particularly from the tastes and odors that emanate from petroleum products.

STODDARD SOLVENT

COMMON SYNONYMS:	CHEMICAL COMPOSITION	CAS REG NO / NIOSH NO
Dry cleaning safety solvent Mineral spirits PD-680 Solvent naphtha Stoddard solvent White spirits	Approximate Composition Linear and branched alkanes 30.0% - 50.0% Cycloalkanes 30.0% - 40.0% Aromatics 10.0% - 20.0% Benzene trace Olefins trace	8052-41-3 WJ8925000 AIR W/V CONVERSION FACTOR at 25°C 5.77 mg/m³ = 1 ppm 0.173 ppm = 1 mg/m³ MOLECULAR WEIGHT 135.00-145 (average

REACTIVITY	Stoddard solvent is considered to be a miscellaneous combustible material for compatibility classification purposes. Those with oxidizing mineral acids or organic peroxides or hydroperoxides may produce heat, fire, and toxic gases, while those with strong oxidizing agents may produce heat, fire, and innocuous gases. Reactions with explosive materials may result in an explosion (38, 507, 511).

PHYSICO-CHEMICAL DATA	• Physical State: Liquid (at 20°C)	(2)
	• Color: Colorless	(2)
	• Odor: Mild petroleum	(507)
	• Odor Threshold: 0.900 ppm	(1970)
	• Density: 0.7700 g/mL (at 20°C)	(507)
	• Freeze/Melt Point: No data	
	• Boiling Point: 154.00 to 202.00°C	(2)
	• Flash Point: 37.80 to 60.00°C (variable)	(23,38, 51,507)
	• Flammable Limits: 0.80 to 6.00% by volume	(38,51,506)
	• Autoignition Temp.: 227.0 to 260.0°C (variable)	(23,38,51, 506)
	• Vapor Pressure: 3.00 mm Hg (at 20°C)	(507)
	• Satd. Conc. in Air: 2.20E+04 to 2.40E+04 mg/m³ (at 20°C)	(1219)
	• Solubility in Water: Insoluble	(507)
	• Viscosity: 0.910 to 0.950 cp (at 20°C)	(5)

PHYSICO-CHEMICAL DATA	Surface Tension: No data Log (Octanol-Water Partition Coeff.): 3.16 to 7.06 (See Table 67-2) • Soil Adsorp. Coeff.: 7.00E+02 to 5.50E+06 (See Table 67-2) • Henry's Law Const.: 4.40E-04 to 7.40 atm · m^3/mol (at 20°C) (See Table 67-2) • Bioconc. Factor: No data
PERSISTENCE IN THE SOIL-WATER SYSTEM	Stoddard solvent hydrocarbons are expected to be relatively mobile and moderately persistent in most soil systems. Persistence in deep soils and groundwater may be higher. Volatilization, photooxidation and biodegradation are potentially important fate processes. Surface spills are expected to be weathered by evaporation and photooxidation. Downward migration of weathered surface spills and sub-surface discharges represent a potential threat to underlying groundwater. Biodegradation of C7-C12 hydrocarbons is expected to be significant under environmental conditions favorable to microbial oxidation; naturally-occurring, hydrocarbon-degrading microorganisms have been isolated from polluted soils and, to a lesser extent, non-polluted soils.
PATHWAYS OF EXPOSURE	The primary pathway of concern from the soil/groundwater systems is the contamination of ground water drinking water supplies resulting from large spills of Stoddard solvent or leaking underground storage tanks. Vapors from leaked or spilled solvent may diffuse through soils and migrate into structures resulting in inhalation exposures. Inhalation exposures may also occur from the direct volatilization of surface spills. Ingestion with food is not expected to be significant.

HEALTH HAZARD DATA	Signs and Symptoms of Short-term Human Exposure: (38) Overexposure to Stoddard solvent causes irritation of the eyes, nose and throat and may cause dizziness. Prolonged overexposure to the liquid may cause skin irritation. Acute Toxicity Studies: INHALATION: LC_{Lo} 10,000 mg/m³ 2.5 hr Cat (4?) Long-Term Effects: kidney damage Pregnancy/Neonate Data: Fetotoxic at maternally toxic doses Genotoxicity Data: Negative Carcinogenicity Classification: IARC - No data NTP - No data EPA - No data
HANDLING PRECAUTIONS (38,507)	Handle only with adequate ventilation • Vapor levels of 500 to 1000 ppm: chemical cartridge respirator with a full facepiece and organic vapor cartridges • 1000 to 5000 ppm: any supplied-air respirator or self-contained breathing apparatus with full facepiece; gas mask with organic vapor canister • Chemical goggles if there is probability of eye contact • The use of impermeable gloves is advised to prevent skin irritation.

ENVIRONMENTAL AND OCCUPATIONAL STANDARDS AND CRITERIA

AIR EXPOSURE LIMITS:

Standards
- OSHA TWA (8-hr): 100 ppm
- AFOSH PEL (8-hr TWA): 100 ppm; STEL (15-min): 150 ppm

Criteria
- NIOSH IDLH (30-min): 5000 ppm
- NIOSH REL (10-hr TWA): 350 mg/m^3
- NIOSH CL (15-min): 1800 mg/m^3
- ACGIH TLV® (8-hr TWA): 100 ppm
- ACGIH STEL (15-min): STEL deleted

WATER EXPOSURE LIMITS:

Drinking Water Standards
None established.

EPA Health Advisories and Cancer Risk Levels
None established.

WHO Drinking Water Guideline
No information available.

EPA Ambient Water Quality Criteria
- Human Health (355)
  - No criterion established; Stoddard solvent is not a priority pollutant.
- Aquatic Life (355)
  - No criterion established; Stoddard solvent is not a priority pollutant.

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APPENDIX D-3

TRAINING DOCUMENTATION

CERTIFICATE OF COMPLETION

This is to certify that:

RUSSELL B. KROHN

has completed eight hours of Management/Supervisor refresher training in Hazardous Waste Site Operations. This training was designed to satisfy the requirements of the Department of Labor published in Title 29, Code of Federal Regulations, Part 1910.120, Paragraphs (e) (8).

January 4, 1993

DATE

Caryl M. Olmstead

CARYL M. OLMSTEAD

NORTHWEST REGIONAL

HEALTH AND SAFETY MANAGER

Tetra Tech, Inc

VA 249

CERTIFICATE OF COMPLETION

This is to certify that:

JENNA MEAD

has completed eight hours of Management/Supervisor refresher training in Hazardous Waste Site Operations. This training was designed to satisfy the requirements of the Department of Labor published in Title 29, Code of Federal Regulations, Part 1910.120, Paragraphs (e) (8).

January 4, 1993

DATE

Caryl M. Olmstead

CARYL M. OLMSTEAD

NORTHWEST REGIONAL
HEALTH AND SAFETY MANAGER

Tetra Tech, Inc

174 150

CERTIFICATE OF COMPLETION

This is to certify that:

JULIE M. WESTHOFF

has completed eight hours of Management/Supervisor refresher training in Hazardous Waste Site Operations. This training was designed to satisfy the requirements of the Department of Labor published in Title 29, Code of Federal Regulations, Part 1910.120, Paragraphs (e) (8).

January 4, 1993

DATE

Caryl M. Olmstead

CARYL M. OLMSTEAD

NORTHWEST REGIONAL
HEALTH AND SAFETY MANAGER

Tetra Tech, Inc

CERTIFICATE OF COMPLETION

This is to certify that:

MICHELLE R. BECKMAN

has completed eight hours of Management/Supervisor refresher training in Hazardous Waste Site Operations. This training was designed to satisfy the requirements of the Department of Labor published in Title 29, Code of Federal Regulations, Part 1910.120, Paragraphs (e) (8).

January 4, 1993

DATE

Caryl M. Olmstead

CARYL M. OLMSTEAD

NORTHWEST REGIONAL

HEALTH AND SAFETY MANAGER

Tetra Tech, Inc

24 452

CERTIFICATE OF COMPLETION

This is to certify that:

RANDY OVERTON

has completed eight hours of Management/Supervisor refresher training in Hazardous Waste Site Operations. This training was designed to satisfy the requirements of the Department of Labor published in Title 29, Code of Federal Regulations, Part 1910.120, Paragraphs (e) (8).

January 4, 1993
DATE

Caryl M. Olmstead
CARYL M. OLMSTEAD
NORTHWEST REGIONAL
HEALTH AND SAFETY MANAGER

Tetra Tech, Inc

24 453

CERTIFICATE OF COMPLETION

This is to certify that:

PAMELA L. MCKEE

has completed eight hours of Management/Supervisor refresher training in Hazardous Waste Site Operations. This training was designed to satisfy the requirements of the Department of Labor published in Title 29, Code of Federal Regulations, Part 1910.120, Paragraphs (e) (8).

January 4, 1993

DATE

Caryl M. Olmstead

CARYL M. OLMSTEAD

NORTHWEST REGIONAL
HEALTH AND SAFETY MANAGER

Tetra Tech, Inc

74 454

APPENDIX D-4

TAILGATE SAFETY LOG

DAILY TAILGATE SAFETY MEETING FORM

'24 156

Date:_____ Time:_____ Job Number._____

Client:_____

Site Location:_____

Scope of Work:_____

_____

Safety Topics Presented

Planned Field Activities for the day:_____

_____

Protective Clothing/Equipment:_____

_____

Chemical Hazards:_____

_____

Physical Hazards:_____

_____

Special Equipment:_____

_____

Decontamination Procedures:_____

_____

Other:_____

_____

Emergency Procedures:_____

_____

Hospital:_____ Phone:_____ Ambulance Phone:_____

Hospital Address and Route:_____

_____

Employee Questions/Comments._____

_____

_____

ATTENDEES

NAME PRINTED	SIGNATURE
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Meeting Conducted By:

_____ _____

Name Printed/Signature Name Printed/Signature

_____ _____

Site Safety Coordinator Project Manager

APPENDIX D-5

INSTRUMENT INSTRUCTION/CALIBRATION PROCEDURES

HNU PHOTOIONIZER OPERATING INSTRUCTIONS

1. Before attaching the probe, check the function switch on the control panel to make sure it is in the OFF position. Attach the probe by plugging in the 12 pin plug to the interface on the readout module.

2. Turn the six position function switch to the battery check position. The needle on the meter should read within or above the green battery arc on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

3. Turn the function switch to any range setting. Look into the end of the probe briefly to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe for any length of time as UV light can damage your eyes. The instrument is now ready for operation.

4. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. Note: No gas is needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary readjust the zero.

5. To make a MEASUREMENT, set the function switch on the 0-2000 range setting. Introduce the unknown gas into the instrument, and change the range setting as needed.

CALIBRATION

Static or dynamic gas generation systems can be utilized for calibration of the instrument. A number of such systems for generating test atmospheres for various gases have been described by G.O. Nelson in "Controlled Test Atmospheres", Ann Arbor Science Publishers, Ann Arbor, Michigan (1971).

The most convenient packages for calibration are the non-toxic analyzed gas mixtures available from HNU Systems in pressurized containers (Catalogue #101-350).

A rapid procedure for calibration involves bringing the probe and readout in close proximity to the calibration gas, cracking the valve on the tank and checking the instrument reading. This provides a useful spot check for the instrument.

The recommended and most accurate procedure for calibration of the instrument from a pressurized container is to connect one side of a "T" to the pressurized container of calibration gas, another side of the "T" to a rotameter and the third side of the "T" directly to the 8" extension to the photoionization probe (Figure 5). Crack the valve of the pressurized container until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample required for detection, and the flow in the rotameter indicates an excess of sample. Now adjust the span pot so that the instrument is reading the exact value of the calibration gas. (If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted, if necessary).

CALIBRATION CHECKING WITH ISOBUTYLENE

The calibration of the analyzer can be rapidly checked by the use of an HNU small disposable cylinder containing isobutylene (HNU pn 101-350) with a regulator (HNU pn 101-351). At the factory, the analyzer is first calibrated on the desired gas standard at the specified concentration. Then a measurement is made with isobutylene.

The ppm reading along with the span setting using isobutylene is recorded in the calibration report.

In service, the analyzer calibration can be checked and readjusted if necessary by using this cylinder and regulator as follows:

a. Connect the analyzer to the regulator and cylinder with a short piece (butt connection) of tubing as shown in Figure 1. The calibration gas in the cylinder consists of a mixture of isobutylene and zero air. Isobutylene is nontoxic and safe to use in confined areas. There are no listed exposure levels at any concentration.

   The regulator sets and controls the flow rate of gas at a value preset at the factory. This will be about 250 cc/min.

   It is important that the tubing be clean since contaminated tubing will effect the calibration reading. Do not use the cylinder below about 30 psig as readings below that level can deviate up to 10% from the rated value.

   Safely discard the disposable cylinder when empty. Do not refill this cylinder. It is against the law to transport refilled cylinders.

b. With the SPAN setting and the function switch at the same positions as listed in the Application Data Sheet or Calibration Report, open the valve on the cylinder until a steady reading is obtained.

c. If the reading is the same as the recorded data, the analyzer calibration for the original species of interest is still correct.

d. If the reading has changed, adjust the SPAN setting until the reading is the same

e. Shut off the cylinder as soon as the reading is established.

f. Record and maintain this new SPAN setting. Then recalibrate the analyzer on the species of interest as soon as possible.

g. Whenever the analyzer is recalibrated, it is to be immediately checked with the small cylinder and the reading recorded. This can then be used for later checking in the field.

MINI-RAM
(Miniature Real-time Aerosol Monitor)
Model PDM-3

1. Ensure that the Ni-Cd batteries of the MINI-RAM have been charged (see Battery Charging instructions).

2. Once the batteries of the MINI-RAM have been recharged the display (LCD Readout) may indicate one of the following conditions:

   - o **BLANK DISPLAY**: indicates that the Mini-Ram has not been in the measurement mode for 48 hours or more, and is the minimum power off mode.
   - o **"OFF" DISPLAY**: indicates that the MINI-RAM has been in the off mode for less than 48 hours.
   - o **CONCENTRATION DISPLAY**: a changing or "blinking" display once every 10 seconds indicates that the MINI-RAM is in the MEASUREMENT mode

3. To start the MEASUREMENT CYCLE.

   - o If the MINI-RAM indicates a BLANK DISPLAY, press OFF and wait (approximately 5 seconds) until the display reads "OFF" before pressing MEAS to initiate the measurement cycle.
   - o If the MINI-RAM shows "OFF", press MEAS directly to initiate the measurement cycle.

The first readout displayed is either "GO" or "CGO" (if TIME is also pressed - see instruction manual) which will be followed by the last concentration reading or " 00". The first new 10-second-averaged concentration reading will be displayed approximately 36 seconds after pressing MEAS All readings are concentration values expressed in milligrams per cubic meter (mg/m^3) and are updated every 10 seconds. (The instrument will operate continuously in the measurement mode for 500 minutes). The concentration average and elapsed time information will be stored in the instrument after it stops operating in the measurement mode. The measurement mode can only be interrupted by pressing the "OFF" switch (key). (NOTE: The instrument normally operates in the 00 to 9.99 mg/m^3 range Whenever a 10-second concentration exceeds 9.99 mg/m^3 the MINI-RAM display will automatically switch to the 0 to 99.9mg/m^3 range and will remain in this range for as long as the 10-second measured concentration exceeds 9.99 mg/m^3).

When operating the MINI-RAM in high particle concentration environments (>5 mg/m^3) a zero value should be performed approximately every 8 hours (see operations manual) At concentrations below 1 mg/m^3 an update of the zero value is only required once a week

(Refer to the operations manual for the functions performed on the remaining touch switches: MEAS and TIME, OFF, TIME, TWA, SA, and PBK).

Battery Charging Instructions

1. Plug charger into A.C. line.

2. Connect charger plug into corresponding MINI-RAM receptacle.

3. Leave charger connected to MINI-RAM for a minimum of 12 hours before using instrument without the charger.

RADIATION DETECTOR METER

VICTOREEN MODEL 490, THYAC III

1. Ensure that two "D" cell batteries are installed in the unit. The battery box is at the end of the case bottom.

2. Verify that the instrument is properly calibrated. A low-intensity uranium beta source called an operational check source is fastened to the side of the case bottom. This source may be used in conjunction with any of the beta-sensitive probes connected to the instrument in order to verify operability and to check the constancy of calibration The beta shield is retracted to expose the perforated guard near the center of the Geiger tube guard. One of the square openings is then placed directly over the 3/8-in diameter circle on the operational check source, under which the beta source is located. A reading of approximately 2,000 counts/min. will result for a properly operating instrument. This check must be carried out in the absence of any additional appreciable radiation fields from other sources. If the counting rate obtained on a specific combination of probe and instrument is retained, a periodic repeat of this procedure will check the constancy of calibration of the instrument and probe combination. The Model 489-35 probe can be checked in a similar manner by removing the plastic alpha and beta cap from the end of the probe and placing the probe on the operational check source directly over the circle identifying the location of the source. A reading of approximately 2,700 counts/min. should be obtained The alpha and gamma sensitive scintillation probes applicable to this instrument are not sensitive to the beta radiation emanating from the check source, and therefore cannot be checked with it.

3. With the instrument off, connect the detector probe by inserting the connector on the probe cable into the coaxial receptacle to the right of the handle post. Press down and turn clockwise for about 1/4 turn and release to lock the bayonet catches on their mating connector pins

4. Turn the instrument on to the battery check position, and see that the meter reads in the indicated zone.

5. Turn the switch to the highest usable range. For scintillation type detectors this is the X1000 range, while for GM detectors this is the X10 range.

NOTE

The instrument cannot be used with a GM probe on the X1000 range. Any attempt to do so will result in a highly erroneous reading.

6. Place the probe in the location to be measured. If the meter reading is less than 10 percent of full scale, switch to the next lowest range. Continue this procedure until the meter reads above 10 percent of full scale.

7. Select an appropriate response speed. The Model 490 offers four choices of meter response time, designated slow, medium, and fast. These correspond to approximately 15 second, 5 second, and 1.5 second, and 4.5 second for 95 percent response. The desired response time is selected by the top-mounted switch designated RESPONSE. The choice of response speed is dictated by the desired accuracy in reading (the slower the response, the more accurate the reading) and the range on which the reading is to be made. Generally, the slow response will be used on the two

most sensitive ranges for a very accurate reading. The medium response will be used for the majority of readings. The fast response will be used on the X1000 range and when the radiation field may fluctuate rapidly, as in a survey type measurement.

Normally the lower back counts/min. scale should be used with the reading modified by the proper range multiplier. The upper red scale in mR/h is designed to be read only when the Models 489-4 and 489-35 Geiger tube probes are used as gamma radiation detectors. In this case, the red scale may be used to read an approximate radiation intensity in mR/h for radium gammas or other hard gamma fields such as 137CS and 60 CO.

C. QUALITY ASSURANCE PROJECT PLAN

C. QUALITY ASSURANCE PROJECT PLAN

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APPENDIX

C. QUALITY ASSURANCE PROJECT PLAN

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared in support of site investigations at Richards-Gebaur Air Force Base (AFB), Missouri. The purpose of the QAPP is to delineate guidelines and procedures that will be followed to ensure that the data collected during field activities are of sufficient quality and representativeness for its intended use. The project description, objectives, and proposed field activities are presented in the Work Plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The organization, functional responsibilities for key staff, levels of authority among key participants, and lines of communication for activities affecting the QAPP for this project are presented in the Program Organization Chart for Tetra Tech, Inc. and PACE, Inc. personnel (Figure C-1). Following are brief descriptions of each area of responsibility.

2.1 Project Personnel

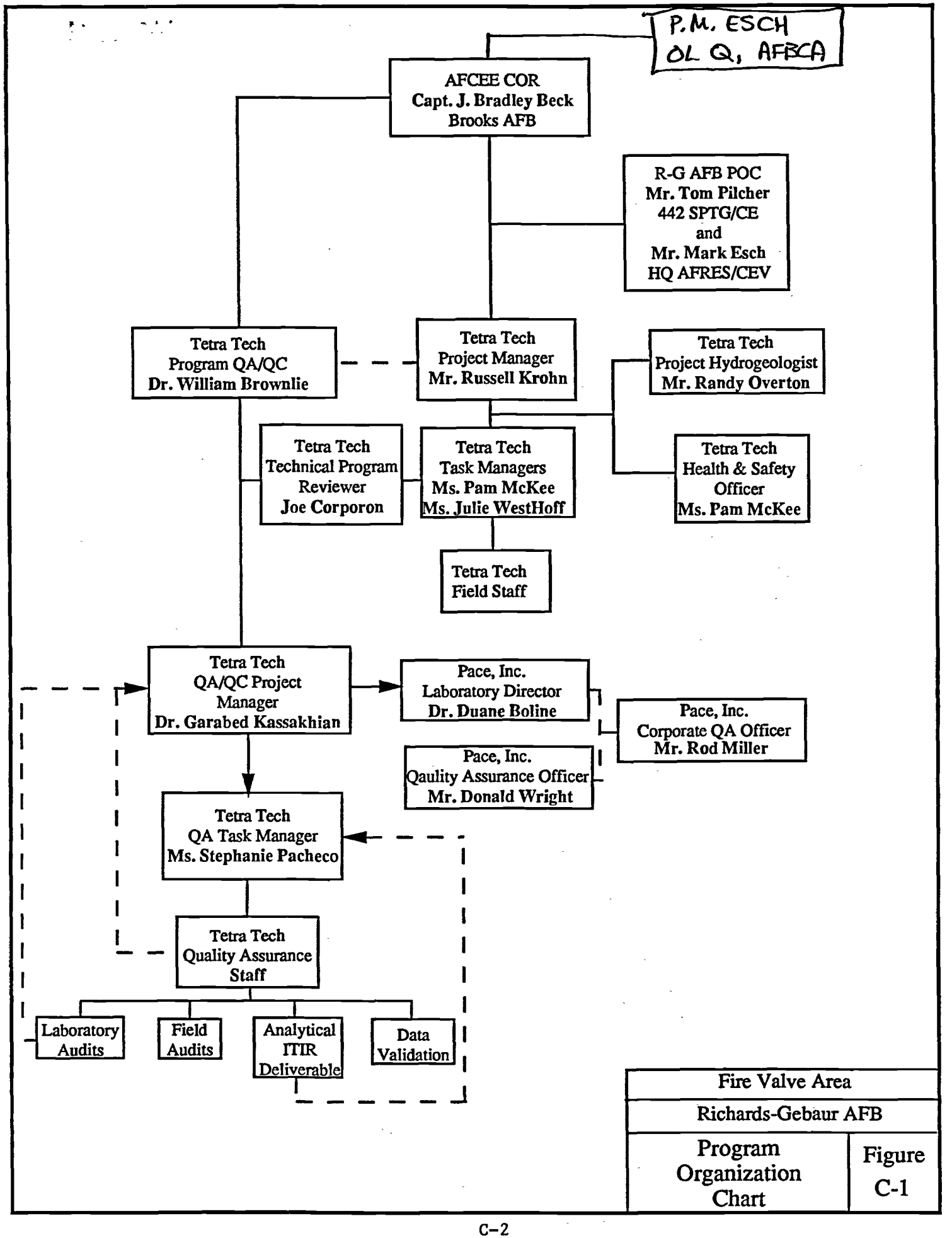
Captain J. Bradley Beck is the Contract Officer's Representative (COR) for this work effort at Richards-Gebaur AFB. He is located at Brooks AFB in San Antonio, TX.

Mr. Tom Pilcher and Mr. Mark Esch are the Points of Contact (POC) at Richards-Gebaur AFB. Mr. Esch will be taking over Mr. Pilcher's responsibilities as Base POC for this project in the Fall of 1993.

The Tetra Tech, Inc. Project Manager, Mr. Russell B. Krohn, is responsible for ensuring that sample collection activities are performed in a manner to satisfactorily meet the data quality objectives of the project; for ensuring that adequate quality control provisions are incorporated into the project to ascertain that data obtained will be of known quality; and for the formal review and approval of site-specific sampling procedures and analytical requirements contained in the Work Plan and QAPP. Throughout the project, the Project Manager will maintain contact with the COR concerning project activities.

The Tetra Tech, Inc. Task Manager, Ms. Julie WestHoff, will direct all site sampling activities and review this QAPP for technical accuracy. The Task Managers are responsible for ensuring that site activities and sampling activities are performed according to the procedures outlined in this QAPP.

The Tetra Tech, Inc. Program QA/QC Manager, Dr. William Brownlie, is designated as the Installation Restoration Program (IRP) Program QA/QC Manager. He remains independent of



Fire Valve Area	
Richards-Gebaur AFB	
Program Organization Chart	Figure C-1

the costs, scheduling, and other performance constraints that are the responsibilities of the Project Manager.

The Tetra Tech, Inc. Technical Program Reviewer, Mr Joe Corporon, is responsible for providing the final technical review of all deliverables prior to submittal to the U.S. Air Force

The Tetra Tech, Inc. Project QA/QC Manager, Dr. Garabed Kassakhian, is the overall Manager of the Quality Assurance Department. Dr. Kassakhian's responsibilities include laboratory oversight of PACE, Inc., verification of PACE, Inc.'s compliance with this QAPP, and review of PACE's Standard Operating Procedures (SOPs) as needed. His responsibilities also include review of all Tetra Tech, Inc. field sampling protocols and plans to ensure that the Data Quality Objectives (DQOs) set for this work effort are met during sample collection. He will provide direct oversight for laboratory audits, ensure prompt laboratory evaluations, and interface with laboratory management regarding QA/QC issues.

The Tetra Tech, Inc. QA/QC Task Manager, Ms. Stephanie Pacheco, is responsible for all project-related QA/QC elements associated with this work effort. As such, she provides direct oversight of the field activity auditors, as well as the data validation staff. She also reviews deliverables containing validated data, such as the Analytical Informal Technical Information Reports (ITIR).

The Tetra Tech, Inc. Project Hydrogeologist, Mr. Randy Overton, will provide technical support to the task managers during different phases of the investigation.

The Tetra Tech, Inc. Health and Safety Officer, Ms. Pam McKee, is responsible for ensuring that all health and safety issues are addressed as outlined in the Tetra Tech site-specific Health and Safety Plan.

The Tetra Tech, Inc. Field Activities Team will adhere to all appropriate sample acquisition, handling, analyses, and documentation procedures outlined in this QAPP and the Work Plan Specifically, field personnel will be responsible for the completion of all sample handling and documentation forms, including sample identification labels, chain-of-custody seals, etc.

2.2 Analytical Laboratory Organization and Responsibilities

PACE, Inc., 9608 Loiret Blvd., Lenexa, KS 66219, (913) 599-5665, will provide analytical services for this work effort at Richards-Gebaur AFB.

The Regional Office Director of PACE, Inc., Lenexa, Kansas, is Dr. Duane R. Boline. Dr Boline will be the Project Manager at PACE, Inc. and Ms. Christina Scharff, Assistant Regional Director, will act as Assistant Project Manager. The managers for organic, inorganic, and support services departments report directly to Dr. Boline.

Dr. Donald C. Wright is the Regional Quality Assurance Officer (QAO) and is responsible for ensuring that all activities of the laboratory are in compliance with PACE corporate policy for quality. The Regional QAO reports to the Regional Director (i.e., Dr. Boline) for administrative matters and then directly to PACE's Corporate QAO, Rod Miller, for all matters related to quality assurance and quality control within the laboratory. The Regional QAO has the authority and the responsibility to implement and approve corrective actions as needed. The QAO is responsible for monitoring quality control (QC) sample analysis results and the results obtained for analyses of external performance samples to identify potential problems. He is responsible for initiating both preventive and corrective actions as needed to ensure proper operations within the laboratory. The QAO is responsible for operation of the quality control program within the region, and for maintaining certifications required for regional operations. Unacceptable findings will be reported to PACE's Corporate QAO, Rod Miller; PACE's Project Manager, Dr. Boline; Tetra Tech's Project Manager, Russell Krohn; and Tetra Tech's Project QA/QC Manager, Dr. Kassakhian.

3.0 QUALITY ASSURANCE OBJECTIVES FOR ANALYTICAL DATA

Data quality objectives (DQOs) are qualitative and quantitative statements developed by data users to specify the quality of data from field and laboratory data collection activities to support specific decisions or regulatory actions. The DQOs describe what data are needed, why the data are needed, and how the data will be used to address the problem under investigation. DQOs also establish numeric limits for the data to allow the data user (or reviewers) to determine whether data collected are of sufficient quality for use in their intended application.

Data needed for this investigation include both screening measurements and data of sufficient quality to be used to develop a quantitative risk assessment.

A full contract laboratory program (CLP) analytical program at EPA Data Quality Level IV will not be utilized. The EPA has established a hierarchy of DQOs which are qualitative and quantitative statements that specify the quality of data required to support regulatory decisions during remedial response (U.S. EPA, 1987). For data collection during this investigation at the Richards-Gebaur AFB, the main analytical program will be performed at a fixed base laboratory using U.S. EPA Data Quality Level III, with rigorous documentation performed according to the Handbook to Support the Installation Restoration Program (IRP) Statements of Work (Handbook) (U.S. Air Force, IRP Division, 1991) requirements. The field screening analyses included in the field gas chromatograph (GC) and geophysical surveys will require U.S. EPA Data Quality Level II protocol.

Quality criteria to be employed at this site addresses the following data characteristics: accuracy, precision, completeness, representativeness, and comparability. These criteria are discussed below.

3.1 Definition of Criteria

3.1.1 Accuracy

Accuracy is the degree of agreement of a measurement or average of measurements within an accepted reference or "true" value, and is a measure of bias in the system. For this project, accuracy of the measurement data will be assessed and controlled. Field instruments have a potential accuracy which is specified by the manufacturer. The ability to obtain this level of accuracy depends on proper calibration. For the laboratory, results of method blank analysis, as well as reagent, matrix, and surrogate QC sample results, will be the primary indicators of accuracy. These results will be used to control accuracy within acceptable limits by requiring that they meet specific criteria. As these spiked QC samples are analyzed, spike recoveries will be calculated and compared to pre-established laboratory acceptance limits. The calculation formula for percent recovery is:

$$\% \text{ Spike Recovery} = \frac{[\text{Value of Sample} + \text{Spike Added}] - [\text{Value of Unspiked Sample}]}{[\text{Value of Spike Added}]} \times 100$$

Acceptance criteria, also termed "control limits", will be based on previously established (i.e., historical) laboratory capabilities for similar samples using control chart techniques. In this approach, the control limits reflect the minimum and maximum recoveries expected for individual measurements for an in-control system. Recoveries outside the established control limits indicate some assignable cause, other than normal measurement error, and the possible need for corrective action. Corrective action could include recalibration of the instrument, reanalysis of the QC sample, reanalysis of the samples in the batch, or flagging the data as suspect if the problem cannot be resolved. These results will be reported to the QA/QC Officers and the PACE Project Coordinator.

According to the Handbook resampling may be performed if samples exceed their specific holding time requirements or are not preserved properly. If second column analysis, where appropriate, is not performed within the specified holding time, resampling may be undertaken.

3.1.2 Precision

Precision is defined as a measure of mutual agreement of a measurement or average of measurements (with the same property under prescribed similar conditions) with an accepted reference of "true" value. Precision of the measurement data gathered during this investigation will be based on QC sample analyses (repeatability), replicate analyses (replicability), and results obtained from duplicate/replicate field samples (sample replicability).

Precision is independent of the error (accuracy) of the analyses and reflects only the degree to which the measurements agree with one another, not the degree to which they agree with the "true" value for the parameter measured. Precision is calculated in terms of Relative Percent Difference (RPD), which is expressed as follows:

$$RPD = \frac{[X1 - X2]}{\frac{[(X1 + X2)]}{2}} \times 100$$

where: X1 and X2 represent the reported concentrations for each of the two duplicate/replicate analyses.

RPDs must be compared to the laboratory-established RPD for the analysis. For concentrations less than 10 times the detection limit, RPD criteria are not valid, and variations may be as great as 100 percent. In the event that either X1 or X2 is not detected, and the other is detected below the detection limit and is reported as an estimated value, an RPD will not be calculated. Precision of duplicates may depend on sample homogeneity. Initial spike concentrations will be greater than the detection limits and will have a range comparable to those stated in SW-846 (U.S. EPA, 1990).

When RPDs exceed previously established control limits, corrective action will be taken to include recalibration, reanalysis of the matrix, etc. RPDs outside the established control limits may indicate some assignable cause, other than normal measurement errors, and the need for corrective action. Follow-up action can include recalibration, reanalysis of the matrix spike/matrix spike duplicates (MS/MSD) QC sample, environmental sample reanalysis, or flagging the data as suspect if the problem cannot be resolved.

Replicate analysis of control samples will be obtained when QC samples specific to the environmental samples are analyzed. Analytical precision will be evaluated from MS/MSD RPD analyses. Use of duplicate samples during analysis can also allow a measure of precision to be determined.

Field duplicates are defined as two samples collected independently at a single sampling location during a single act of sampling. Field duplicates will make up 10 percent of the original sample number. Field duplicates will be collected for groundwater samples and analyzed for the same parameters.

A field replicate is defined as a single sample that is collected, then divided into two equal parts for the purpose of analysis. Field replicates will number 10 percent of the original sample number. Field replicates will be collected for soil/sediment samples and analyzed for the same

parameters. Discretely sampled field duplicates/replicates are useful in determining sampling variability. However, greater than expected differences between replicates may occur because of variability in the sample material. In these instances, a visual examination of the sample material will be performed to document the reason for the difference. Field sample duplicates/replicates shall be used as a QC measure to monitor precision relative to sample collection activities. Analytical precision shall be evaluated using RPDs for MS/MSD or duplicate samples.

3.1.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under correct, normal conditions. The target value for completeness of all parameters is 100 percent. Measurement data completeness is a measure of the extent that the database resulting from specific measurement effort fulfills the objectives for the amount of data required. For this program, completeness will be defined as the valid data percentage of the total test requested as follows:

$$\text{Completeness (\%)} = \frac{\text{Number of Successful Analyses}}{\text{Number of Requested Analyses}} \times 100$$

In order for an individual analysis to be considered successful, the sample container for a specific parameter (i.e., metals) must have arrived at the laboratory intact, properly preserved, and in sufficient quantity to perform the requested analyses; accompanied by a completed chain-of-custody form; and analyzed within the specified holding time and according to QC acceptance criteria.

Completeness for the entire project also involves elements specific to field and laboratory documentation of sample collection. This includes documentation detailing whether samples and analyses specified in the Work Plan have been processed using the procedures outlined in the QAPP, and whether laboratory SOPs have been implemented.

Completeness values for laboratory parameters are addressed in Section 3.2 of this document. For this work effort, a completeness value of 90 percent will be considered acceptable. Failure to achieve this goal may require resampling and reanalysis.

3.1.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness describes how well the data reflect site

conditions in the vicinity of the data point at the time of collection. Representativeness may be maintained or attained by careful documentation of data collection procedures and adherence to standard data collection procedures.

The characteristics of representativeness are usually not quantifiable. Subjective factors to be taken into account are as follows:

- o Degree of homogeneity of a site
- o Degree of homogeneity of a sample taken from one point on site
- o Available information on which a sample plan is based.

Field duplicates and field replicates, as defined under precision, are also used to assess representativeness. Two samples which are collected at the same time are considered to be equally representative of the site, at a given point in space and time. Soil borings and well locations will be chosen to represent the areas of interest at the site. To maximize representativeness of results, sampling techniques, sample size, sample locations, and depths will be carefully selected so they provide laboratory samples that are representative of the site and the specific area.

Since soil and sediment samples are less homogeneous than water, the sampler and analyst must exercise good judgement when removing a sample. Samples exhibiting obvious stratification or lithologic changes should not be used as replicates. Within PACE, Inc., precautions are taken to extract from the sample an aliquot representative of the whole sample. The soil sample is mixed and foreign objects are removed, and a representative aliquot is removed for analysis. For samples requiring volatile organic compound analysis, premixing or homogenizing samples will be avoided.

Properly installed monitoring wells ensure that the water being sampled originates from the water-bearing horizon of concern. Care must be taken to ensure proper stabilization of measured water parameters, clarity, and color before groundwater samples are taken. Precautions concerning the location of internal combustion engines with respect to a well during sampling must be taken so that introduction of extraneous compounds does not affect the representativeness of the samples.

3.1.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. For instance, sample data from this effort may be compared to data from background locations, to established criteria, or to data from earlier sampling events. Comparability is attained by careful adherence to standardized sampling procedures and

rigorous documentation of sample descriptions (including location, depth, time, and date). Comparability is ensured through the use of established and approved sample collection techniques and analytical methods, consistency in the basis of analytes (wet weight, volume, etc.), consistency in reporting units, and analysis of standard reference materials

Data comparability will be achieved by using standard units of measure as specified in the Handbook, [i.e., milligrams per liter (mg/ℓ) for metals in water samples; milligrams per kilogram (mg/kg) for metals in soil samples; μg/ℓ and mg/kg for organics in water and soil, respectively; and mg/ℓ for TCLP metals and organics. Soil weights are measured on a dry weight basis. The use of standardized methods to collect and analyze samples (in this case, American Society of Testing and Materials [ASTM] and U.S. EPA methods), along with instruments calibrated against National Institute for Standards and Technology (NIST) and U.S. EPA-traceable standards, will also ensure comparability.

Comparability also depends on other data quality characteristics. Only when data are judged to be representative of the environmental conditions, and when precision and accuracy are known, can data sets be compared with confidence.

3.2 Goals for Assessment Criteria

Project quality objectives for various measurement parameters associated with site characterization efforts cannot be quantified for representativeness and comparability. The following elements delineate assessment criteria discussed in detail elsewhere in the QAPP:

- o Laboratory accuracy limits for PACE, Inc., are presented in Section 8.0 for each method, as are analytical criteria;
- o Overall precision for this work effort, which includes both sampling and analytical factors, can be expected to show RPDs up to 30 percent for soils and water samples;
- o A completeness factor of 90 percent is acceptable for this investigation; and
- o Representativeness and comparability are subjective and cannot be quantitated.

If accuracy and precision limits are not met, data will be flagged accordingly and possible explanations for the deviation(s) will be discussed in the QA/QC section of the RFA report. In the event that a completeness factor of 90 percent is not attained, resampling may be necessary to meet the objectives of the project.

4.0 FIELD SAMPLING PROCEDURES

4.1 Sampling Protocols

Water, soil, and/or sediment samples may be collected during field activities for laboratory analysis. In addition to field samples and field QC samples discussed in the Field Sampling Plan (FSP - Section B of this Work Plan), a sample of jet fuel will potentially be collected for submittal to the laboratory for use as a standard. The FSP provides a description of the field sampling procedures that will be used for field activities performed at Richards-Gebaur AFB.

4.2 Laboratory Operations

All sample log-in, storage, and internal chain-of-custody documentation will follow the Standard Operating Procedures of PACE, Inc. Regional Laboratory as described in the following sections.

4.2.1 Sample Handling

Samples are received in accordance with the procedures set forth in PACE Standard Operating Procedure (SOP) number All-Q-004 "Sample Receipt and Check-in"; this SOP is included as Appendix C-1. Shipping containers are inspected for custody seals and the condition is noted in the sample receipt log. The shipping containers are then opened in a chemical fume hood by the Sample Custodian and inspected for enclosed documentation. The temperature inside the shipping container is noted by measuring the accompanying temperature blank with a mercury thermometer, which has been calibrated versus an NIST traceable standard thermometer. The temperature is then recorded on the chain-of-custody form. The sample bottles are inspected for breakage and/or evidence of leakage, and the sample bottle labels are inspected and compared to the chain-of-custody.

If the temperature blank is outside the acceptance range of 4 $\pm$ 2 °C, The PACE, Inc. Project Manager will immediately notify Tetra Tech's Project Manager and QA/QC Task Manager by telephone, followed by a confirmation fax message. The samples will be rejected and a resampling event will be performed.

The chain-of-custody is compared to the Project Alert Form provided by the PACE, Inc. Project Manager. Any discrepancy noted is described on a discrepancy report form and the PACE, Inc. Project Manager is notified immediately. The Project Manager is responsible for contacting Tetra Tech and determining the corrective action required. The action taken is recorded on the Discrepancy Report Form (Figure C-2) and maintained in the project file [PACE SOP ALL-Q-008-B, "Discrepancy Reports," (Appendix C-2)].

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PACE, Inc.
9608 Loiret Boulevard
Lenexa, Kansas 66219

DISCREPANCY REPORT

File Name:
Date:
Page:

MN-P-001-C

PACE, INCORPORATED
DISCREPANCY REPORT

	Routing Sequence		
	Initial	Date	
Initiator			
PM			cc: Initiator
QA			cc: Mgr/Supr

DR. No. _____
(OBTAIN FROM QA)

DR. Code _____ QA Use:

(INITIATOR)

Client:

Supervisor's Initials:

PM:

Project No:

Sample(s):

Analysis:

Discrepancy:

Proposed Resolution:

(PROJECT MANAGER)

PM's Initials: Date:

Client Contact: Yes ( ) No ( )

PM Comments:

Client Comments:

Figure C-2: Discrepancy Report Form and Associated Documents

DISCREPANCY REPORT

File Name:

Date:

MN-P-001-C

Page:

DISCREPANCY CODES

1. **Holding Time**
   - 1.0 Checked in out of holding
   - 1.1 Dilution run out of holding
   - 1.2 Arrived out of holding
   - 1.3 Short holding time parameter - sample arrived after hours
   - 1.4 Arrived after >50% holding time had expired
   - 1.5 Miscellaneous
   - 1.6 Holding time not applicable to matrix

2. **Lost Samples**
   - 2.0 Checked in out of holding
   - 2.1 Sample misplaced during analysis
   - 2.2 Miscellaneous

3. **Preservation**
   - 3.0 Not preserved
   - 3.1 Inadequately preserved (wrong type, insufficient)

4. **Sample Volume**
   - 4.0 Insufficient sample provided by client
   - 4.1 Insufficient sample as a result of analysis (VOA, Inorganic)
   - 4.2 Headspace present
   - 4.3 Extract final volume suspect

5. **Lab Accident**
   - 5.0 As a result of check-in/storage
   - 5.1 During analysis

6. **Contamination**

7. **O.C. Outlier**
   - 7.0 Matrix
   - 7.1 Spiking error
   - 7.2 Instrumental
   - 7.3 Preparation problem

8. **Improper Check-in of Sample**
   - 8.0 Client error
   - 8.1 PACE error

9. **Nonproject Related**
   Discrepancy (i.e., cooler out of control)

10. **Miscellaneous**

DISCREPANCY REPORT	File Name:
	Date:
MN-P-001-C	Page:

DISCREPANCY REPORT PROCEDURE

1. The Initiator completes the top half of the form.

2. The Initiator obtains a discrepancy report (DR) number from Quality Assurance (QA) via phone (x3454 or x3417) or by going directly to the clipboard used to assign numbers and summarize DRs.

3. The Initiator writes the number in the "DR. No." blank in the upper left-hand corner of the form.

4. The Initiator takes the form to the appropraite project manager (PM) to work out a solution and/or notify the client.

5. The PM writes his/her notes on the form and contacts the client, if needed.

6. The PM notes any comments or resolutions achieved via client contact. PM completes bottom half of form.

7. The PM routes a copy of the completed form to the Initiator (or notifies the Initiator verbally) and routes the original to QA.

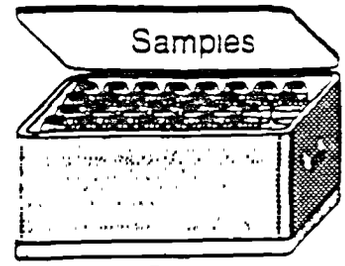
Samples are logged in the PACE, Inc. Laboratory Data Management System (LDMS) in accordance with the LDMS User's Manual and PACE, Inc. SOP No. ALL-Q-004-A "Sample Receipt and Check-in" (Appendix C-1). The sample receiving process is summarized in the flow chart included as Figure C-3. All forms used in conjunction with sample receipt and responsibilities are included in the referenced SOPs, which are included in the Appendices.

Upon entry of all required sample tracking and analysis information into the LDMS, a Sample and Analyses Data Entry Form (SADEF) (Figure C-4) and a Sample Condition Upon Receipt Form (SCUR) (Figure C-5) are printed. These forms and other accompanying paperwork are distributed to the Department Managers and the Project Manager in accordance with the procedures set forth in the referenced SOP. Copies of the SADEF and SCUR forms are reviewed by the PACE, Inc. Project Manager for accuracy and completeness and mailed to the client for verification and approval of the analyses requested.

A bound, permanent logbook will be maintained by PACE, Inc. Sample Custodian to document the following information:

- Date samples were received;
- The source of the samples;
- PACE, Inc. specific sample identification;
- All analytical tests requested for that specific batch of samples;
- Matrix;
- Number of samples associated with that specific batch; and
- Final disposition of the samples.

Samples are stored in accordance with the procedures set forth in PACE, Inc. SOP No. ALL-Q-007-A "Sample Storage"; this SOP is included in Appendix C-3. All forms used for Sample Storage are included in the referenced SOP. The Sample Custodian is responsible for sample storage under appropriate conditions. The sample containers are stored in designated, locked refrigerators according to the type of analyses to be performed. Samples to be analyzed for volatile organic compounds are stored in the organic volatiles laboratory. Other sample containers are stored in the common refrigerated storage area which is accessed only by sample control personnel. All refrigerators are monitored daily by a designated member of the Sample Custodian's staff to ensure the temperature is maintained at 4° C $\pm$2° C. Deviations from this temperature range are noted on the temperature log sheet, the Sample Custodian is notified, and corrective action is taken immediately to ensure the integrity of the samples.



CHECK-IN

In Storage
(Cooler)

IN STORAGE
REFRIGERATOR

SAMPLE PREP

SAMPLE ANALYSIS

DATA PRODUCTION
Analytical Results QC Results

CONTROL
CHARTS

DATA ENTRY
Data are entered into LDMS

QUALITY
ASSURANCE
OFFICER

DATA VALIDATION
Analyst / Supervisor Validates both QC & Sample Results

REPORT GENERATION

QC
DELIVERABLES

REPORT REVIEW
Project Manager / Dept. Manager Review / Sign

REPORT SENT TO CLIENT

SAMPLES RETURNED TO CLIENT

SAMPLE DISPOSAL

United States Air Force

Laboratory Sample
Flow Schematic

Figure
C-3

tAT23/02

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PACE, Inc.
9608 Loiret Boulevard
Lenexa, KS 66219

Date: Page:

SAMPLE AND ANALYSIS DATA ENTRY FORM - NEW SAMPLE(S)

Client No.:
Client Contact:
Address:

Telephone No.:

Project No.:
Due Date:
Client P.O. No.:
Project Manager:
Project Name:
Manager's Name:
Project Type:
Analytical Report Style:
QC Level:
Description:

Sample No.:
Collected Date:
Collected By:
Laboratory Received Date:
Checked-In By:
Priority:
Due Date:
Sample Description:
Bottle Types:
Comment:
Matrix:
Analysis Abbreviation:

PACE, INC. RESERVES THE RIGHT TO RETURN ALL SAMPLES AT ITS DISCRETION.

Figure C-4: Sample and Analysis Data Entry Form

SAMPLE CONDITION UPON RECEIPT CHECKLIST

Client:_____ Project #:_____

Date Received:_____

Complete this checklist (A) during sample receipt. If any items are marked NO, the bottom of this form (B) must also be completed. Otherwise, proceed with check-in of samples.

Section A

YES	NO	1.	Is a chain of custody (COC) or documentation containing information normally contained on a COC present?
YES	NO	2.	Is the date and time relinquished in agreement with that written on the letter or COC?
YES	NO	3.	Do the samples received agree with the COC or accompanying paperwork (i.e. number of samples, matrices, sample tags, sample containers, analyses, etc.)?
YES	NO	4.	Are all the samples within the holding times for requested analysis? Communicate any lapse of greater than 4 days beyond date of collection for VOA analysis.
YES	NO	5.	Are the sample containers intact (i.e., not broken leaking, etc.)?
YES	NO	6.	Are the samples at the proper temperature? Temp in C°_____
YES	NO	7.	Is there sufficient sample quantity to perform all requested analyses?
YES	NO	8.	Are the samples preserved correctly?
YES	NO	9	Are the VOA vials head-space free?

Section B

Explain NO items here: _____

_____

_____

Figure C-5: Sample Condition Upon Receipt Checklist

4.2.2 Sample Identification

Each sample received by PACE, Inc. will be given a discrete identification number to link the sample to the identity given by the Tetra Tech, Inc. sampler. The sample identification number will consist of the current year, followed by the month and a two- or three-digit sequential number assigned by PACE, Inc. to aid in tracking the sample during analysis. This unique numbering system will enable PACE, Inc. to accurately track the sample as it is analyzed, dates and times of analysis, the QA/QC for that sample, and the final disposition of that sample.

4.2.3 Sample Custody Records

PACE, Inc. follows standard operating procedures to assure the integrity of samples, prevention of degradation, and to prevent disclosure of data to unauthorized personnel. In order to ensure that this policy is maintained effectively, the laboratory facilities at Lenexa, Kansas, are operated under controlled access (SOP No. KS1-G-0101-A) "Laboratory Security Procedures" (Appendix C-4). Only employees are allowed into the laboratory. Visitors must register upon arrival and are allowed access to the facility only with an escort.

Policies and procedures for maintaining internal chain-of-custody of samples are contained in PACE, Inc. SOP No. ALL-Q-009-A "Internal Chain-of-Custody"; this SOP is included as Appendix C-5.

5.0 CALIBRATION PROCEDURES AND FREQUENCIES FOR FIELD TEST EQUIPMENT

Field equipment will be calibrated prior to use in the field as appropriate. The calibration procedures will follow standard manufacturers' instructions and/or Tetra Tech, Inc.'s calibration procedures (Section B-3.0 of the FSP). This will ensure that equipment used in the field will function within the tolerable range specified by the manufacturer and within the range required by the project. In addition to regularly scheduled calibration, some instruments such as the pH meter or the photoionization detector (PID) will require calibration checks prior to use. The data points generated as a result of calibration will be recorded on calibration sheets or field logbooks by field personnel. Periodic calibration records will also be recorded and filed in a calibration logbook. All instruments will be monitored for evidence of non-reproducible or erratic readings, and recalibration will be performed as necessary. Calibration requirements are detailed in Section B-3.0 of the FSP. Copies of the instrument manuals will be readily accessible for all field personnel. All records of calibration results will be subject to audit by a member of Tetra Tech, Inc.'s QA auditing staff.

All instruments are to be stored, transported, and handled with care to preserve equipment accuracy and minimize downtime. Damaged instruments shall be taken out of service

immediately and not used again until a qualified technician repairs and recalibrates the instrument.

6.0 ANALYTICAL PROCEDURES

Target analytes and the analytical methods used by PACE, Inc. for this work effort are presented in Table C-1. For each analysis, the following information is included in Table C-1: parameter name, reference and method number, the matrix, analyte of interest, and matrix-specific practical quantitation limits (PQLs). The terminology and how the limits were established are described in Section 6.2. Method detection limits and instrument detection limits are presented in Appendix C-6. Parameters applicable to the Fire Valve area include: total petroleum hydrocarbons, volatile organic compounds, and semi-volatile organic compounds. Additional parameters listed are included in case conditions in the field warrant different analyses.

Table C-2, in combination with Section 8.0 of this QAPP, provide QC criteria for the analytical program used with this work effort. There may be instances where high analyte concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the detection limits or associated QC criteria. In such instances, the reason for deviations from the detection limits or associated QC criteria will be reported in an Anomaly Report and in the laboratory QC report, which are described in detail in Section 12 of this QAPP.

6.1 Analytical Methods

Standard analytical methods to be used for the sample analyses are referenced in the following documents:

- Test Methods for Evaluating Solid Waste,SW-846, 3rd Edition, U.S. EPA, 1986b (revised 1990);
- Methods for Chemical Analysis of Water and Wastes, U.S. EPA 1983; and
- Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup and Underground Storage Tank Closure, State of California, 1989.

The rationale for the selection of the parameters and methods used for this work effort are described in detail in the Work Plan; however, a brief discussion is provided in this QAPP

6.1.1 Metals Analysis

All soil samples will be prepared for metals analysis using U.S. EPA Method 3050. Method 3051 may also be used by the laboratory for preparing samples for metals analysis, as appropriate. Water samples for graphite furnace (GF) and inductively coupled plasma (ICP)

Table C-1

Practical Quantitation Limits for Target Analytes
PACE, Inc. Regional Laboratory

Parameters	Method W=Water S=Soil/Sed.	Analyte	Water (µg/ℓ)	Soil (mg/kg)
Metals	SW3050/SW6010(S) SW3010/SW6010(W)	Molybdenum	0.10	10
		Nickel	0.05	5
		Silver	0.03	3
		Vanadium	0.05	5
		Zinc	0.02	2
		Aluminum	0.05	5
		Calcium	0.10	10
		Iron	0.05	5
		Magnesium	0.10	10
		Manganese	0.01	1
		Potassium	1	100
		Sodium	0.20	20
		Barium	0.01	1
		Beryllium	0.001	0.10
		Cadmium	0.005	0.5
		Chromium	0.02	2
		Cobalt	0.05	5
		Copper	0.01	1
	SW3050/SW7041(S) SW3020/SW7041(W)	Antimony	0.010	1
	SW3050/SW7841(S) SW3020/SW7841(W)	Thallium	0.010	1
	SW3050/SW7421(S) SW3020/SW7421(W)	Lead	0.005	0.5
	SW3050/SW7060(S) SW3020/SW7060(W)	Arsenic	0.005	0.5
	SW3050/SW7740(S) SW3020/SW7740(W)	Selenium	0.005	0.5
	SW7470(S) SW7471(W)	Mercury	0.0002	0.5
			(µg/ℓ)	(mg/kg)
Total Petroleum Hydrocarbons	SW5030/SW8015 Modified	Purgeable Total Petroleum Hydrocarbons	400	5
	SW3510/SW3520/ SW8015 Modified	Extractable Total Petroleum Hydrocarbons	400	5
Chlorinated Herbicides	SW8150	2,4-D	12	0.8

Table C-1, Page 2 of 6
Practical Quantitation Limits for Target Analytes

Parameters	Method W=Water S=Soil/Sed.	Analyte	Water (µg/ℓ)	Soil (mg/kg)
Chlorinated Herbicides (cont.)	SW8150	2,4-DB	9	0.6
		2,4,5-T	2	0.1
		2,4,5-TP (Silvex)	1.7	0.1
		Dalapon	60	4.0
		Dicamba	2.7	0.2
		Dichloroprop	6.5	0.5
		Dinoseb	3.1	0.65
		MCPA	2500	170
		MCPP	1900	130
Organochlorine Pesticides & PCBs	SW3520/SW8080(W) SW3550/SW8080(S)	Aldrin	0.04	0.0015
		alpha-BHC	0.03	0.0015
		beta-BHC	0.05	0.0015
		delta-BHC	0.05	0.0015
		gamma-BHC (Lindane)	0.04	0.0015
		Chlordane (alpha and gamma)	0.05	0.0015
		4,4'-DDD	0.1	0.003
		4,4'-DDE	0.09	0.003
		4,4'-DDT	0.1	0.003
		Dieldrin	0.05	0.003
		Endosulfan I	0.05	0.0015
		Endosulfan II	0.1	0.003
		Endrin aldehyde	0.1	0.003
		Endrin	0.06	0.003
		Endosulfan sulfate	0.1	0.003
		Heptachlor	0.03	0.002
		Heptachlor epoxide	0.05	0.002
		Methoxychlor	0.5	0.015
		Toxaphene	2.5	0.16
		PCB-1016	1.0	0.03
		PCB-1221	1.0	0.03
		PCB-1232	1.0	0.03
		PCB-1242	1.0	0.03
		PCB-1248	1.0	0.03
		PCB-1254	1	0.03
		PCB-1260	1	0.03

Table C-1, Page 3 of 6
Practical Quantitation Limits for Target Analytes

Parameters	Method W=Water S=Soil/Sed.	Analyte	Water (µg/ℓ)	Soil (mg/kg)
Volatile Organic Compounds	SW5030/SW8240 (W&S)	Acetone	10	0.026
		Benzene	5	0.005
		Bromodichloromethane	5	0.005
		Bromoform	5	0.005
		Bromomethane	10	0.010
		2-Butanone (MEK)	10	0.026
		Carbon disulfide	5	0.005
		Carbon tetrachloride	5	0.005
		Chlorobenzene	5	0.005
		Chlorodibromomethane	5	0.005
		Chloroethane	10	0.010
		2-Chloroethyl vinyl ether	10	0.010
		Chloroform	5	0.005
		Chloromethane	10	0.029
		1,1-Dichloroethane	5	0.005
		1,2-Dichloroethane	5	0.005
		1,1-Dichloroethene	5	0.005
		cis-1,2-Dichloroethene	5	0.005
		trans-1,2-Dichloroethene	5	0.005
		1,2-Dichloropropane	5	0.005
		cis-1,3-Dichloropropene	5	0.005
		trans-1,3-Dichloropropene	5	0.005
		Ethylbenzene	5	0.005
		2-Hexanone	10	0.011
		Methylene chloride	5	0.005
		4-Methyl-2-pentanone	10	0.010
		Styrene	5	0.005
		1,1,2,2-Tetrachloroethane	5	0.005
		Tetrachloroethene	5	0.005
		Toluene	5	0.005
		1,1,1-Trichloroethane	5	0.005
		1,1,2-Trichloroethane	5	0.005
		Trichloroethene	5	0.005
		Vinyl acetate	10	0.010
		Vinyl chloride	10	0.010
		Xylenes (total, all isomers)	5	0.005

Table C-1, Page 4 of 6
Practical Quantitation Limits for Target Analytes

Parameters	Method W = Water S = Soil/Sed.	Analyte	Water (µg/ℓ)	Soil (mg/kg)
Semi-volatile Organic Compounds	SW3550/SW8270(S) SW3510/SW8270(W)	**Base/Neutral Extractables**		
		Acenaphthene	10	0.3
		Acenaphthylene	10	0.3
		Anthracene	10	0.3
		Benzo(a)anthracene	10	0.3
		Benzo(b)fluoranthene	10	0.3
		Benzo(k)fluoranthene	10	0.3
		Benzo(ghi)perylene	10	0.3
		Benzo(a)pyrene	10	0.3
		Benzyl alcohol	10	0.3
		bis(2-chloroethoxy) methane	10	0.3
		bis(2-ethylhexyl) phthalate	10	0.3
		bis(2-chloroethyl) ether	10	0.3
		bis(2-chloroisopropyl) ether	10	0.3
		4-Bromophenyl phenyl ether	10	0.3
		Butyl benzyl phthalate	10	0.3
		4-Chloroaniline	10	0.3
		2-Chloronaphthalene	10	0.3
		4-Chlorophenyl phenyl ether	10	0.3
		Chrysene	10	0.3
		Dibenzo(a,h) anthracene	10	0.3
		Dibenzofuran	10	0.3
		Di-n-butylphthalate	10	0.3
		1,2-Dichlorobenzene	10	0.3
		1,3-Dichlorobenzene	10	0.3
		1,4-Dichlorobenzene	10	0.3
		3,3'-Dichlorobenzidine	20	0.6
		Diethyl phthalate	10	0.3
		Dimethyl phthalate	10	0.3
		2,4-Dinitrotoluene	10	0.3
		2,6-Dinitrotoluene	10	0.3
		Fluoranthene	10	0.3
		Fluorene	10	0.3
		Hexachlorobenzene	10	0.3
		Hexachlorobutadiene	10	0.3
		Hexachlorocyclopentadiene	10	0.3

Table C-1, Page 5 of 6
Practical Quantitation Limits for Target Analytes

Parameters	Method W=Water S=Soil/Sed.	Analyte	Water (µg/ℓ)	Soil (mg/kg)
Semi-volatile Organic Compounds (cont.)	SW3550/SW8270(S) SW3510/SW8270(W)	Hexachloroethane	10	0.3
		Indeno(1,2,3-cd)pyrene	10	0.3
		Isophorone	10	0.3
		2-Methylnaphthalene	10	0.3
		Naphthalene	10	0.3
		2-Nitroaniline	50	1.6
		3-Nitroaniline	50	1.6
		4-Nitroaniline	50	1.6
		Nitrobenzene	10	0.3
		N-Nitrosodimethylamine	10	0.3
		N-Nitrosodipropylamine	10	0.3
		Phenanthrene	10	0.3
		Pyrene	10	0.3
		1,2,4-Trichlorobenzene	10	0.3
		Acid Extractables		
		Benzoic Acid	50	1.6
		4-Chloro-3-methylphenol	10	0.3
		2-Chlorophenol	10	0.3
		2,4-Dichlorophenol	10	0.3
		2,4-Dimethylphenol	10	0.3
		4,6-Dinitro-2-methylphenol	50	1.6
		2,4-Dinitrophenol	50	1.6
		2-Methylphenol	10	0.3
		4-Methylphenol	10	0.3
		2-Nitrophenol	10	0.3
		4-Nitrophenol	50	1.6
		Pentachlorophenol	10	1.0
		Phenol	10	0.3
		2,4,5-Trichlorophenol	50	1.6
			(mg/ℓ)	(mg/kg)
Toxicity Characteristic Leaching Procedure	SW1311/SW3010/SW6010	Arsenic	0.25	*
	SW1311/SW3010/SW6010	Barium	5	*
	SW1311/SW3010/SW6010	Cadmium	0.05	*
	SW1311/SW3010/SW6010	Chromium	0.25	*
	SW1311/SW3010/SW6010	Lead	0.25	*

Table C-1, Page 6 of 6
Practical Quantitation Limits for Target Analytes

Parameters	Method W = Water S = Soil/Sed.	Analyte	Water (µg/ℓ)	Soil (mg/kg)
Toxicity Characteristic Leaching Procedure	SW1311/SW3010/SW6010	Selenium	0.25	*
	SW1311/SW3010/SW6010	Silver	0.25	*
	SW1311/SW7470	Mercury	0.01	*
	SW1311/SW5030/SW8240	Benzene	1	*
	SW1311/SW5030/SW8240	Carbon tetrachloride	0.1	*
	SW1311/SW5030/SW8240	Chloroform	0.1	*
	SW1311/SW5030/SW8240	1,2-Dichloroethane	0.1	*
	SW1311/SW5030/SW8240	1,1-Dichloroethylene	0.1	*
	SW1311/SW5030/SW8240	Methyl ethyl ketone	0.2	*
	SW1311/SW5030/SW8240	Tetrachloroethylene	0.1	*
	SW1311/SW5030/SW8240	Trichloroethylene	0.1	*
	SW1311/SW5030/SW8240	Vinyl chloride	0.2	*
	SW1311/SW3510/SW8270	o-Cresol	0.1	*
	SW1311/SW3510/SW8270	m-Cresol	0.1	*
	SW1311/SW3510/SW8270	p-Cresol	0.1	*
	SW1311/SW3510/SW8270	1,4-Dichlorobenzene	0.1	*
	SW1311/SW3510/SW8270	2,4-Dinitrotoluene	0.1	*
	SW1311/SW3510/SW8270	Hexachlorobenzene	0.1	*
	SW1311/SW3510/SW8270	Hexachloro-1,3-butadiene	0.1	*
	SW1311/SW3510/SW8270	Hexachloroethane	0.1	*
	SW1311/SW5030/SW8240	Nitrobenzene	0.1	*
	SW1311/SW5030/SW8240	Pentachlorophenol	0.1	*
	SW1311/SW3510/SW8270	Pyridine	0.1	*
	SW1311/SW3510/SW8270	2,4,5-Trichlorophenol	0.1	*
	SW1311/SW3510/SW8270	2,4,6-Trichlorophenol	0.5	*

Notes: 8270: The soil/sediment detection limits listed here are based on an MDL study performed with a 30 g solid matrix.

8240: Soil/sediment detection limits listed here are based on an MDL study performed using a 5 g solid matrix direct sparge purge and trap.

1311: The PQL values listed for organic compounds are based upon the analyses of aqueous standards per the U.S. EPA recommended procedure. The values in this table represent a 1:10 dilution of the TCLP leachate analyzed for extractable organics and 1:20 dilution of the TCLP Leachate analyzed for volatile organics. This dilution is necessary to minimize the matrix effect of the TCLP leaching solution.

* TCLP analysis is performed on the leachate of a soil sample, so the values have been placed in the water column.

The methods cited are from *Test Methods for Evaluating Solid Waste*, SW-846, 3rd Edition, (U.S. EPA, 1986b (revised 1990).

Table C-2

Summary of Calibration Procedures

Method and Instrument	Parameter	Calibration	Frequency	Acceptance Criteria	Corrective Action
7421 7060 7740 7470/7471 7041 7841 (AA)	Pb As Se Hg Sb Tl	Minimum three points (five points for Hg)	Daily prior to analyses	r ≥0.995	Recalibrate if appropriate
		Initial calibration check	After calibration	±10% for 7421, 7060, 7740, 7041, 7841, 7470, and 7471	1) Rerun 2) Recalibrate as appropriate
		Continuing calibration check standard	10% plus end of run	±20% for 7421, 7060, 7740, 7041, 7841, 7470, and 7471	Recalibrate as appropriate
		Calibration blank	After initial calibration	≤Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last blank
6010 (ICP)	Metals	Laboratory mixed standard calibration	Daily prior to analyses	Measured value for calibration standard ±10% of expected value	Recalibrate if appropriate
		Calibration blank	After initial calibration	≤Detection limit	1) Rerun 2) Clean system
		ICP interference check	Run at beginning of daily run, after 8 hours, and at end of run	80-120% of true value for EPA check sample elements	Recalibrate if appropriate
		Initial calibration check	After calibration	±10%	Recalibrate if appropriate
		Continuing calibration check standard	10% plus end of run	±20% for 7421, 7060, 7740, 7041, 7841, 7470, and 7471	Recalibrate as appropriate
8015 Modified	Total Petroleum Hydrocarbons	Minimum three points each of gasoline, diesel, and jet fuel	Initially and as required	RSD ≤20%	1) Evaluate system 2) Repeat calibration
		Continuing calibration check standard	Every 24 hours	±15%	1) Evaluate system 2) Reanalyze standard 3) Recalibrate if appropriate
8080 (GC/ECD)	Organochlorine Pesticides and PCBs	Minimum five points	Initially and as required	r ≥0.99 or % RSD for RF ≤25%	Recalibrate as necessary

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Table C-2, Page 2 of 2
Summary of Calibration Procedures

Method and Instrument	Parameter	Calibration	Frequency	Acceptance Criteria	Corrective Action
8080 (GC/ECD) (continued)		Continuing calibration check standard	Daily, before sample analyses	± 20%	1) Evaluate system 2) Reanalyze standard 3) Recalibrate if appropriate
8150 (GC/MS)	Chlorinated Herbicides	To Be Determined	To Be Determined	To Be Determined	To Be Determined
8240 (GC/MS)	Volatile Organics	Tune instrument using Bromofluorobenzene	Every 12 hours	Refer to method (SW846)	1) Retune instrument 2) Repeat BFB analysis
		Minimum five points	Initially and as required	% RSD for CCCs ≤30% Avg. RF ≥0.30 (0.25 for CHBr) for SPCCs	1) Evaluate system 2) Recalibrate as necessary
		Continuing calibration check standard	Every 12 hours	RF ≥0.30 (0.25 for bromoform) for SPCCs % Difference ≤30% for CCCs	1) Evaluate system 2) Repeat calibration check 3) Recalibrate as appropriate
8270 (GC/MS)	Semi-volatile Organics	Check of instrument tuning criteria using DFTPP	Every 12 hours	Refer to method (SW846)	1) Retune instrument 2) Repeat DFTPP analysis
		Minimum five points	Initially and as required	% RSD for CCCs ≤30% Avg. RF ≥0.050 SPCCs	1) Evaluate system 2) Recalibrate if appropriate
		Continuing calibration check standard	Every 12 hours	RF ≥0.050 for SPCCs % Difference ≤30% for CCCs	1) Evaluate system 2) Repeat calibration check 3) Recalibrate if appropriate

metals analysis will be prepared using U.S. EPA Methods 3020 and 3010, respectively. Water and soil samples for antimony, arsenic, lead, selenium, and thallium analysis will be analyzed by graphite furnace using U.S. EPA Methods 7041, 7060, 7421, 7740, and 7841, respectively. Water and Soil samples for mercury analysis will be analyzed by U.S. EPA cold vapor technique Method 7470 and 7471, respectively. Soil and water samples for the remaining metals analysis will be analyzed by U.S. EPA Method 6010.

6.1.2 Organic Analysis

Soil samples for total petroleum hydrocarbon (TPH) analysis will be prepared by U.S. EPA Method 3550 and analyzed by U.S. EPA Modified Method 8015. Water samples for TPH analysis will be analyzed by U.S. EPA Modified Method 8015. Soil and water samples for volatile organic compounds (VOCs) analysis will be prepared by U.S. EPA Method 5030 and analyzed by Method 8240. Soil samples for semi-volatile organic compounds (semi-VOCs) will be prepared by U.S. EPA Method 3550 and analyzed by Method 8270. Water samples for semi-VOCs will be prepared by U.S. EPA Method 3510 and analyzed by U.S. EPA Method 8270. Soil samples for pesticides/PCBs analysis will be prepared by U.S. EPA Method 3550 and analyzed by U.S. EPA Method 8080. Water samples for pesticides/PCBs analysis will be prepared by U.S. EPA Method 3510 and analyzed by U.S. EPA Method 8080. Soil and water samples for herbicides analysis will be prepared as described in U.S. EPA Method 8150, the method that will be used for herbicides analysis.

6.1.3 Toxicity Characteristic Leaching Procedure Analysis

A waste characterization sample may be collected for Toxicity Characteristic Leaching Procedure (TCLP) analysis. This sample would be analyzed for TCLP metals, volatile organic compounds, and semi-volatile organic compounds.

6.2 Detection Limits

Detection limits are required for all methods of quantitative analysis to evaluate each method's performance. Detection limits for many analytical procedures depend highly on the matrix of the sample or material that is tested. Interferences frequently require sample dilution and/or method modifications that may change the reported detection limits. Limit of detection (LOD) studies for the organic analyses noted previously are performed according to 40 CFR 136 Appendix B, by analysis of a standard solution with each analyte in reagent water, at a concentration of one to five times the expected detection limit, with seven consecutive measurements on one day. Practical quantitation limits (PQLs) are established by multiplying the instrument detection limit by the dilution factor and adjusting for matrix effects.

PACE, Inc. PQLs are presented in Table C-1. The PACE quantitation limits were determined according to the following criteria:

- o If the method detection limit (MDL) is significantly less than the Air Force Center for Environmental Excellence (AFCEE) maximum quantitation limit (MQL), the PQL is set at a minimum of two and a maximum of five times the MDL depending upon the normal baseline stability coincident with the analyte response signal and the proximity of the response signal for other target analytes in multi-analyte methods of analysis

- o If the MDL is greater than 0.5x or equal to the AFCEE MQL, the MQL is established as the PQL in compliance with the contract requirements.

- o If the MDL is greater than the AFCEE MQL, the PQL is set equal to the MDL and a variance request is prepared and submitted to the client.

Calibration standards for organics analyses are prepared at a minimum of three concentrations. One of the standards is at a concentration near but above the method detection limits. The other standard concentrations bracket the analytical range of the instrument. An analysis blank is prepared and analyzed with the calibration standards. A calibration verification standard is prepared from a separate source at a concentration near the middle of the analytical range and analyzed to demonstrate the accuracy of the calibration. All calibration standards and blanks are spiked with surrogate compounds to monitor the performance of the system. Calibration acceptance criteria are presented in Table C-2.

Metals chemistry analyses Method Detection Limits (MDLs) correspond to instrument detection limits. MDLs are established by PACE, Inc., according to the procedure described in the U.S. EPA Contract Laboratory Program Statement of Work for Inorganics Analyses, Exhibit E, Section V, Item 10, "Instrument Detection Limit (IDL) determination. This procedure is required for analyses performed for the U.S. EPA and is followed to ensure only one value is used by the laboratory for reporting an MDL for each metal analysis. A water sample is acid digested and the digestate diluted to the original volume per the preparation methods described in SW-846 methods 3005, 3010, and 3050. Thus the MDL is equivalent to the IDL.

The MDL is established by analyzing a standard solution of analyte in laboratory pure water with a concentration of three to five times the estimated instrument detection limit seven consecutive times on each of three non-consecutive days. The MDL is set at three times the standard deviation of the 21 measurements.

The MDL reported for a specific sample (soil/sediment) is adjusted based upon the percent moisture in the sample. The MDL is reported on a dry weight basis. Samples which contain target analytes in concentrations greater than the analytical range of the instrument must be diluted to obtain accurate quantitation. The dilution thus becomes a part of the method used for the analysis of that specific sample. The MDL is properly represented by multiplying the MDL for an undiluted sample by the dilution factor required to achieve quantitation of the sample. Dilution may also be required due to the presence of high concentration(s) of non-target analytes.

The MDL is multiplied by the dilution factor required to prepare analysis aliquot compatible with the instrumentation used for the analysis. Instrument detection limits (IDLs) and MDLs for PACE, Inc. are presented in Appendix C-6.

Although PACE, Inc. utilizes state-of-art instrumentation, maximum contaminant levels (MCLs) cannot be met in all instances. Therefore, some of the data collected may not be appropriate for risk assessment purposes. However, the data will meet the data quality objectives proposed for this investigation.

7.0 DATA REDUCTION, VALIDATION, AND REPORTING

7.1 Data Management

Calculations from raw data are included in discussions of analytical procedures presented in U.S. EPA methods detailed in SW-846 and other references detailed in the relevant sections of the approved analytical methods. These data reduction and validation procedures will not be repeated in this section. Relevant details of data reduction, validation, and reporting for this work effort will be identified and addressed in this section.

Data storage and documentation will be maintained using logbooks and data sheets that will be kept on file at PACE, Inc. All computer-generated raw data are stored on magnetic tape, floppy disk, or other required media and will be maintained, along with paper copies, by PACE, Inc. for a minimum of seven years after completion of analytical tasks associated with this work effort.

Samples generated during this investigation will be received by PACE, Inc. and logged in by the Sample Custodian. Final results are entered into the LDMS system by the analyst, then independently reviewed/validated by another analyst or supervisor experienced in the method.

Result verification sheets are attached to the QC files and reviewed by either a peer trained in the validation of data or the section supervisor. After this review, the department manager or section supervisor verifies the completeness and the validity of the report. When all required analyses on all of the samples in a project are complete, entered, and validated, a report is printed. The report is forwarded to the Department Manager for technical review. The analytical results and QC data are reviewed and approved by the Department Manager. The report requires the signature of the Project Manager and the Department Manager.

The Project Manager is responsible for tracking the progress of sample analyses and ensuring timely completion of the project. When all analytical results have been obtained, the Project Manager reviews the final report according to data quality criteria established at the outset of the project. Client questions about the final report may be directed to the Project Manager or the Client Services representative assigned to the project.

Complete project files are periodically inventoried and stored off-site in a secure facility, or within locked cabinets on site. Electronic data are copied onto computer tape, inventoried, and stored off site in a secure facility or within locked cabinets on site.

Once received, the final data report is reviewed by the Tetra Tech Project QA/QC Manager. The data are then validated by the data validation staff. This entails reviewing QA/QC data in conjunction with their respective control limits, reviewing nonconformance reports, and ascertaining that the data packet is complete and no data are missing. Figure C-6 presents an organization of staff for the overview and validation of data generated by PACE, Inc. Tetra Tech data validation staff will input the data into the Analytical ITIR format (Figure C-7). The Tetra Tech Project QA/QC Manager and/or QA Auditor will review the final Analytical ITIR for consistency with original laboratory data. The QA Auditor, under the auspices of the Project QA/QC Manager, will provide oversight for the data validation staff as well as periodic review of the ITIR as it is developed.

7.2 Data Reduction

Data reduction calculations to be used on data generated during this work effort are part of PACE, Inc. SOPs. As previously detailed, all data will be calculated and reported in units consistent with other organizations reporting similar data to allow comparability of databases. Data will be reported in milligrams per liter (mg/ℓ) for metals in water samples; milligrams per kilogram (mg/kg) for metals in soil samples; μg/ℓ and mg/kg for organics in water and soil, respectively; and mg/ℓ for TCLP metals and organics. Soil weights are measured on a dry weight basis.

7.3 Data Quality Assessment

7.3.1 PACE, Inc. Regional Laboratory

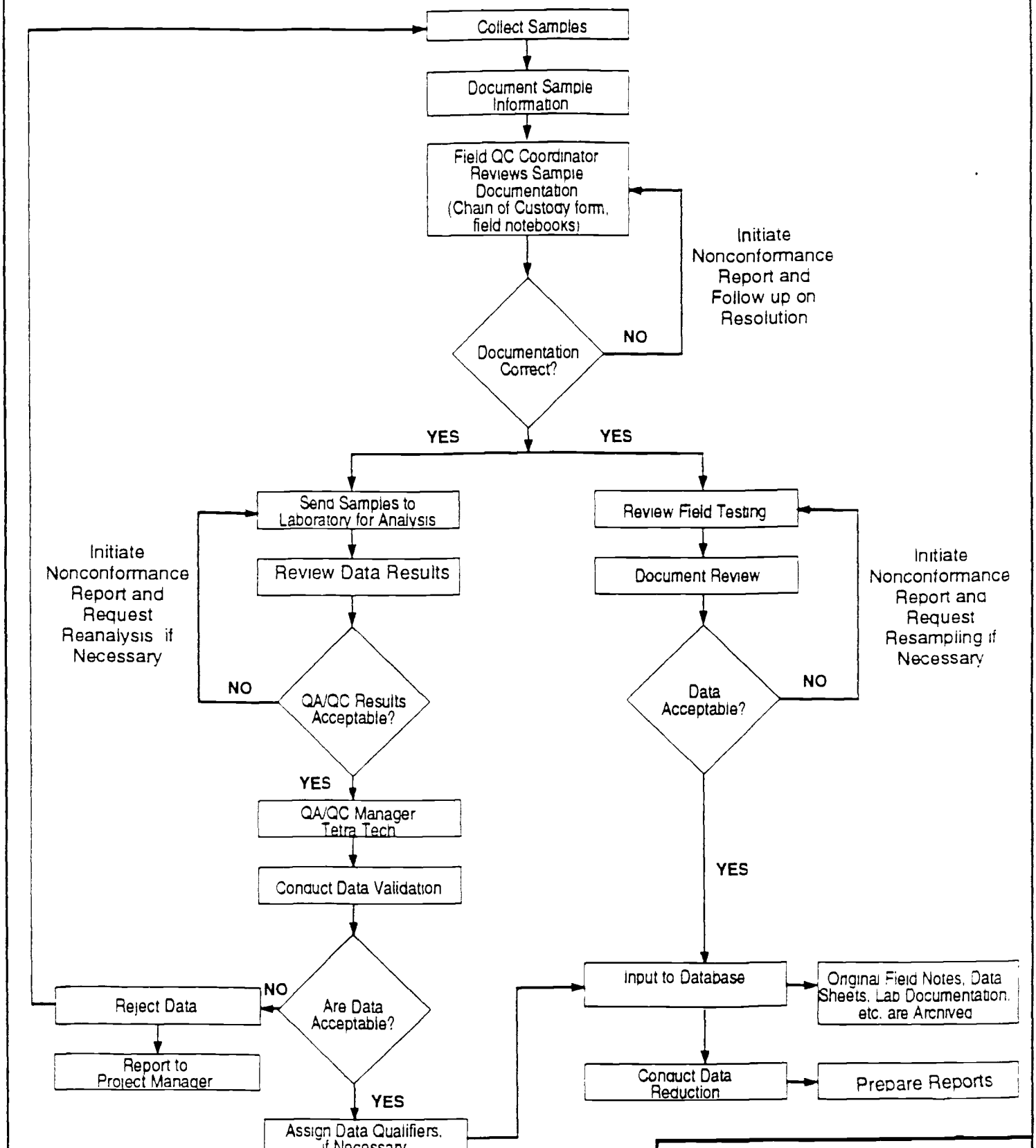
PACE, Inc. has in place an analytical data quality assessment that includes several independent reviews to prevent any erroneous data reporting and correction of problems encountered. The review process includes the following:

- Data generation, reduction, and review by the analyst;
- Review and validation of the analytical data and results by the Laboratory Supervisor;
- Report generation and review by the Department Manager;
- QA Officer review of the report; and
- Project Manager review of the report.

Figure C-6: Analytical Data Review Process, PACE, Incorporated

	Responsibilities
Analyst	• Sample analysis LDMS* entry and generation • Data review - 1st level (bench) • Control charting - real time • Narrative notes • Discrepancy initiation • Provide copies of log books, as necessary
Supervisor	• Oversee daily analytical activities • Review control chart comments daily • LDMS data entry and validating • Review of narrative • Supervise contractual and technical compliance • Discrepancy review • Review quality control daily (calibrations, etc.)
Manager	• Sign-off case narrative • Ensure program compliance • Review discrepancies requiring manager resolution • Technical conference calls with client • Ensure technical validity of data
Data Review	• Generate forms package • Final data review and validate • Prepare package and paginate • Electronic deliverables generation • Maintain data package files
Quality Assurance Office	• 10 percent contractual compliance review (data packages) - Custody when required; - Calculations; - Methods criteria; - QC criteria; - Forms; and - Control charting.
Project Manager	• Review narratives for accuracy • Review packages for completeness and quality • Cover letter • Collate organic and inorganic packages • Client/laboratory liaison • Deliver package to client

Note: *Laboratory Data Management System



United States Air Force

Data Management Flow Chart

Figure C-7

7.3.1.1 Data Generation and Review

The analyst performing a test has the primary responsibility for assessing the accuracy and completeness of the data. The analyst is responsible for using the appropriate laboratory SOP to ensure that the correct method, procedures, and protocols are followed for sample preparation, analysis, and data reduction. The analyst is responsible for the accuracy and completeness of the analytical results and verification of the attainment of acceptable results for QC sample analyses, as specified for the method. Any discrepancies are noted in a project narrative, by a data qualifier, and/or a footnote. The analyst is responsible for having knowledge of project specific requirements and ensuring these are achieved.

7.3.1.2 Review and Validation of the Analytical Data and Results

After the analyst has completed the initial review, the results obtained for the analyses of the environmental and QC samples are entered into the Laboratory Data Management System (LDMS). The Laboratory Supervisor reviews the data on a video display and compares it to the raw data prepared by the analyst. Any discrepancies are noted by keyboard entry of a narrative statement, data qualifier, and/or footnote. Noncompliant data is rejected and corrective action is taken as appropriate for the situation. If the data meet the data objectives for the analysis the results are validated via a keyboard entry.

7.3.1.3 Report Generation and Review

After all analyses have been completed, the results are validated for all samples contained in a project set, and a report is printed. The analysis report contains two sections. The analysis results for all tests performed on all samples in the project set, footnotes, and project narrative comprise the analyses section of the report. This section concludes with a signature requirement for the Department Manager. The second section of the report contains a summary of the results of QC sample analyses performed with the sample set. A cover letter is printed with the report which requires the signature of the Project Manager or Laboratory Director. The report is reviewed by the Department Manager(s). The Department Manager is responsible for ensuring all analyses performed by his/her technical area is accurate and supported by QC analyses within the respective acceptance criteria for the test. Approval of the results is indicated by the Department Manager's signature on the report.

7.3.1.4 QA Officer Review of the Report

The QA Officer is responsible for review of the QC section of the report to ensure that the results obtained for all QC analyses do comply with the project specific requirements. The completeness of the QC analyses is determined by comparing the QC results

reported for an analysis against the QC analyses required for the method. Any discrepancies are noted on a Corrective Action Form and delivered to the Department Manager by the QA Officer. Corrective action is taken as needed to alleviate the problem. The corrective action taken is described on the Corrective Action Form, signed, dated and entered into the project file.

7.3.1.5 Project Manager Review of the Report

The PACE, Inc. Project Manager is responsible for review of the analysis report to ensure completeness and compliance with the project specific requirements. Upon completion of the review, approval is indicated by the signature of the Project Manager on the cover letter of the report.

7.3.2 Tetra Tech

Validation of data generated by PACE, Inc. is the responsibility of Tetra Tech, Inc.'s Project QA/QC Manager and data validation staff. All validation activities will be performed according to the Handbook and, where applicable, the following documents:

- USEPA Contract Laboratory Program, National Functional Guidelines For Organic Data Review (Draft), Multi-Media, Multi-Concentration (OLM01.0) and Low Concentration Water (OLC01.0) (U.S. EPA, 1991);

- USEPA Contract Laboratory Program, National Functional Guidelines for Pesticide and PCB Data Review (Draft), Multi-Media, Multi-Concentration (OLM01.0) and Low Concentration Water (OLC01.0) (U.S. EPA, 1991); and

- USEPA Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (U.S. EPA, 1988).

Data validation procedures, as well as PACE, Inc. SOPs, will be reviewed by Tetra Tech, Inc.'s Project QA/QC Manager. In addition, approximately 10% of all data derived from this work effort will be subjected to a third party validation review. If requested by the U.S. Air Force, Tetra Tech will request magnetic tapes for GC/MS analytical work which will then be submitted to the U.S. EPA for appropriate tape analysis.

Data validation performed by Tetra Tech will consist of a review of many elements associated with the analytical results and will include the following:

7.3.2.1 Relative Percent Difference

RPDs will be compared between field duplicate samples and replicate samples. When

occasional RPDs are greater than 30 percent for soil and water, Tetra Tech, Inc. will attempt to assess if the source of the discrepancy can be ascribed to sample heterogeneity or some other natural cause. If RPDs consistently exceed control limits at any point during the project, sampling or analytical procedures will be reevaluated.

7.3.2.2 Laboratory and Field Blanks

Results of laboratory and field blank analyses will be reviewed for the presence of contaminants. Corrective actions shall be implemented whenever laboratory blank contamination is detected. In the event that contaminants five or ten times (ten times for common laboratory contaminants) the sample results are noted in the blank, the associated data will be appropriately qualified during the data validation process.

7.3.2.3 Laboratory Control Samples

The results of the laboratory control sample and calibration check samples shall be compared to SAP-specified acceptance criteria. Data not within control limits may require corrective action reports. As with the matrix QC samples, when the laboratory control sample results exceed control limits, nonconformance reports will be reviewed by the data validation staff to assess the possible reasons. Table C-3 presents the control limits for laboratory control samples.

7.3.2.4 Matrix Spike/Matrix Spike Duplicate or Duplicate

MS/MSD or duplicate sample data will be reviewed for consistency and compliance with set control limits. In instances where MS/MSD or duplicate results exceed control limits, nonconformance reports will be reviewed by the data validation staff to assess the possible reasons for the exceedance. Table C-4 presents the control limits for MS/MSD analyses.

7.3.2.5 Second Column Confirmations

For samples analyzed by gas chromatography, first column analysis and second column confirmations are to be completed within the appropriate holding times. First and second column analysis results will also be reviewed by the data validation staff. Both results will be recorded along with the primary result, as determined by the laboratory. The second column confirmation sample will also be reviewed for compliance with holding time requirements.

7.4 Data Validation Qualifiers

As part of the internal review by Tetra Tech, Inc.'s data validation staff, the data will be qualified by the data validation staff with the following qualifiers:

J Analyte results are between the Method Detection Limit (MDL) and the Practical Quantitation Limit (PQL), or are deemed qualified and the useability may be limited.

U The analyte was analyzed for, but was not detected above the Method Detection Limit and was indicated with Not Detected (ND);

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte in the sample, or the nondetect result is deemed qualified and useability may be limited;

R The analyte was deemed qualified and not useable and the following descriptors would be used to detail the qualification criteria:

(a) Analyte was found in the method blank.

(b) Surrogate spike exceeded control limits.

(c) Matrix spike/matrix spike duplicate exceeded control limits.

(d) Laboratory control sample exceeded control limits.

(e) Holding time violation occurred.

(f) Laboratory duplicate sample failed precision criteria.

(g) All data met prescribed criteria as detailed in the appropriate QAPP.

(i) Internal standards failed criteria.

(k) The analyte was found in a field blank.

(l) Serial dilution failed criteria.

(q) Instrument calibration (initial calibration verification, initial calibration blank, continuing calibration verification, continuing calibration blank) failed criteria.

Table C-3
PACE, Inc.
Control Limits for Laboratory Control Sample Spikes

Analytical Method	Spiking Compounds	Spike Concentration Water (mg/ℓ)	Spike Concentration Soil/ Sediments (mg/kg)	Laboratory-Established Control Limits Percent Recovery % Water	Laboratory-Established Control Limits Percent Recovery % Soil/ Sediments
6010[1]	Aluminum	1.0	100	75-125	75-125
	Barium	1.0	100	75-125	75-125
	Beryllium	0.1	10	75-125	75-125
	Cadmium	0.1	10	75-125	75-125
	Calcium	10.0	1,000	75-125	75-125
	Chromium	1.0	100	75-125	75-125
	Cobolt	1.0	100	75-125	75-125
	Copper	1.0	100	75-125	75-125
	Iron	1.0	100	75-125	75-125
	Magnesium	10.0	1,000	75-125	75-125
	Manganese	1.0	100	75-125	75-125
	Molybdenum	1.0	100	75-125	75-125
	Nickel	1.0	100	75-125	75-125
	Potassium	10.0	1,000	75-125	75-125
	Silver	1.0	100	75-125*	75-125*
	Sodium	10.0	1,000	75-125	75-125
	Vanadium	1.0	100	75-125	75-125
	Zinc	1.0	100	75-125	75-125
7041[1]	Antimony	0.040	4	75-125	75-125
7060[1]	Arsenic	0.040	4	75-125	75-125
7740[1]	Selenium	0.040	4	75-125	75-125
7470/7471[1]	Mercury	0.002	1.0	75-125	75-125
7421[1]	Lead	0.040	4	75-125	75-125
7841[1]	Thallium	0.040	4	75-125	75-125
		(µg/ℓ)	(mg/kg)		
8015 Modified	Gasoline Fuel	100	10	50-100 (1)	50-150
	Diesel Fuel	20	100	D-180 (1)	53-136
8080	alpha-BHC	0.3	0.010	42-135	18-146
	Lindane (Gamma-BHC)	0.3	0.010	50-132	40-137
	Heptachlor	0.3	0.010	44-134	30-145
	Endosulfan I	0.3	0.010	49-136	62-131
	Dieldrin	0.6	0.020	60-128	73-129
	Endrin	0.6	0.020	67-133	58-146
	4,4'-DDT	0.6	0.020	57-171	35-211
	4,4'-DDD	0.6	0.020	56-120	86-116
	Methoxychlor	0.3	0.010	58-179	35-187
	Aroclor 1254[1]	5.0	0.167	60-145	55-155
8150	2,4-D	5.0	0.167	12-196	D-257
	2,4-DB	5.0	0.167	73-161	D-286
	2,4,5-T	0.5	0.0167	31-163	31-179

Table C-3.
Page 2 of 3

Analytical Method	Spiking Compounds	Spike Concentration: Water (µg/ℓ)	Spike Concentration: Soil Sediments (mg/kg)	Laboratory-Established Control Limits: Percent Recovery %: Water	Laboratory-Established Control Limits: Percent Recovery %: Soil Sediments
8150 (cont.)	2,4,5-TP (Silvex)	0.5	0.016[illegible]	50-144	63-158
	Dalapon	12.5	0.41[illegible]	77-111	D-110
	Dicamba	0.5	0.016[illegible]	31-192	38-226
	Dichloroprop	5.0	0.16[illegible]	33-185	26-203
	Dinoseb	2.5	0.083	D-167	D-189
	MCPA	500	16.[illegible]	22-135	30-136
	MCPP	500	16.[illegible]	27-127	46-126
8240	Chloromethane	50	0.05	D-178	D-20.
	Bromomethane	50	0.05	5-138	27-168
	Vinyl Chloride	50	0.05	D-163	D-244
	Chloroethane	50	0.05	5-163	34-169
	Methylene Chloride	50	0.05	52-133	54-14.
	Acetone	50	0.05	D-171	D-302
	1,1-Dichloroethylene	50	0.05	18-136	29-174
	1,1-Dichloroethane	50	0.05	57-126	44-16[illegible]
	1,2-Dichloroethene	50	0.05	65-129	38-173
	Chloroform	50	0.05	60-123	75-12[illegible]
	1,2 Dichloroethane	50	0.05	65-129	65-13.
	2-Butanone	50	0.05	D-213	D-211
	1,1,1-Trichloroethane	50	0.05	47-138	68-128
	Carbon Tetrachloride	50	0.05	40-141	71-122
	Dichlorobromomethane	50	0.05	71-133	66-12[illegible]
	1,2-Dichloropropane	50	0.05	57-141	74-11[illegible]
	cis-1,3-Dichloropropene	50	0.05	65-123	66-121
	Trichloroethylene	50	0.05	53-126	77-123
	Chlorodibromomethane	50	0.05	60-130	70-128
	1,1,2-Trichloroethane	50	0.05	63-130	67-122
	Benzene	50	0.05	57-138	58-138
	trans-1,3-Dichloropropene	50	0.05	33-147	51-131
	Bromoform	50	0.05	51-138	59-141
	4-Methyl-2-Pentanone	50	0.05	19-144	9-163
	2-Hexanone	50	0.05	D-154	D-218
	Tetrachloroethene	50	0.05	44-138	76-116
	1,1,2,2-Tetrachloroethane	50	0.05	45-148	48-152
	Toluene	50	0.05	66-128	67-125
	Chlorobenzene	50	0.05	69-11[illegible]	77-115
	Ethylbenzene	50	0.05	55-136	69-134
	Styrene	50	0.05	57-137	61-131
	Xylenes (total)	50	0.05	64-125	35-148
8270	Phenol	75	2.5	20-54	11-96
	2-Chlorophenol	75	2.5	27-75	12-111
	1,4-Dichlorobenzene	50	1.7	D-113	4-106
	N-Nitroso-di-n-propylamine	50	1.7	31-183	13-101
	1,2,4-Trichlorobenzene	50	1.7	D-144	12-125

Table C-3,
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Analytical Method	Spiking Compounds	Spike Concentration: Water (µg/ℓ)	Spike Concentration: Soil/ Sediments (mg/kg)	Laboratory-Established Control Limits: Percent Recovery %: Water	Laboratory-Established Control Limits: Percent Recovery %: Soil/ Sediments
8270 (cont.)	4-Chloro-3-Methylphenol	75	2.5	47-75	5-133
	Acenaphthene	50	1.7	18-118	D-137
	4-Nitrophenol	75	2.5	30-115	8-140
	2,4-Dinitrotoluene	50	1.7	D-222	5-123
	Pentachlorophenol	75	2.5	61-91	D-211
	Pyrene	50	1.7	D-133	D-248
		(mg/ℓ)	(mg/kg)		
1311/6010	Arsenic	0.040	N/A	75-125	N/A
	Barium	1.0	N/A	75-125	N/A
	Cadmium	0.1	N/A	75-125	N/A
	Chromium	1.0	N/A	75-125	N/A
	Lead	0.040	N/A	75-125	N/A
	Selenium	0.040	N/A	75-125	N/A
	Silver	1.0	N/A	75-125	N/A
1311/7470	Mercury	0.002	N/A	75-125	N/A
1311/8240	Benzene	50	N/A	57-138	N/A
	Carbon tetrachloride	50	N/A	40-141	N/A
	Chloroform	50	N/A	60-123	N/A
	1,2-Dichloroethane	50	N/A	65-129	N/A
	1,1-Dichloroethylene	50	N/A	18-136	N/A
	Methyl ethyl ketone	50	N/A	D-213	N/A
	Tetrachloroethylene	50	N/A	44-138	N/A
	Trichloroethylene	50	N/A	53-126	N/A
	Vinyl chloride	50	N/A	D-163	N/A
1311/8270	o-Cresol	50	N/A	21-121	N/A
	m-Cresol	50	N/A	22-124	N/A
	p-Cresol	50	N/A	22-124	N/A
	1,4-Dichlorobenzene	50	N/A	D-113	N/A
	2,4-Dinitrotoluene	50	N/A	D-222	N/A
	Hexachlorobenzene	50	N/A	23-207	N/A
	Hexachloro-1,3-butadiene	50	N/A	D-155	N/A
	Hexachloroethane	50	N/A	D-122	N/A
	Nitrobenzene	50	N/A	19-173	N/A
	Pentachlorophenol	75	N/A	61-91	N/A
	Pyridine	50	N/A	D-82	N/A
	2,4,5-Trichlorophenol	75	N/A	3-170	N/A
	2,4,6-Trichlorophenol	75	N/A	34-128	N/A

(1) Percent recoveries interim control limits pending laboratory acquiring minimum number of data points for statistically valid acceptance limits.

N/A Not appropriate

D = Detection limit

* Advisory limit only due to precipitation of silver chloride in the presence of hydrogen chloride

Table C-4

PACE, Inc.
Control Limits for Matrix Spikes, Matrix Spike Duplicates,
and Surrogate Spikes

Analytical Method	Spiking Compounds	Spike Concentration		Laboratory-Established Control Limits			
		Water	Soil/ Sediments	Percent Recovery %		Relative Percent Difference (%)	
		(mg/ℓ)	(mg/kg)	Water	Soil Sediments	Water	Soil Sediments
6010[1]	Beryllium	0.1	0.1	75-125	75-125	20	20
	Cadmium	0.1	1.0	75-125	75-125	20	20
	Chromium	1.0	10	75-125	75-125	20	20
	Copper	1.0	1.0	75-125	75-125	20	20
	Nickel	1.0	1.0	75-125	75-125	20	20
	Zinc	1.0	1.0	75-125	75-125	20	20
7060[1]	Arsenic	0.040	4	55-137	38-148	20	20
7421[1]	Lead	0.040	4	56-137	22-170	20	20
7470/7471[1]	Mercury	0.002	1	79-130	75-125	20	20
7740[1]	Selenium	0.040	4	33-154	54-132	20	20
7041[1]	Antimony	0.040	4	50-148	75-125	20	20
7841[1]	Thallium	0.040	4	22-169	75-125	20	20
		(µg/ℓ)	(mg/kg)				
8015 Modified	**Matrix:**						
	Gasoline Fuel	10.000	50	42-126	4-236	25	25
	Diesel Fuel	2.000	67	21-128	41-146	46	15
	Surrogates:						
	Di-n-octyl phthalate	200	20	21-161	36-158	N A	N A
	Tetracosane	200	20	(2)	38-184	N A	N A
8080	**Matrix:**						
	Lindane (Gamma-BHC)	0.5	0 017	42-142	65-120	32	9
	Heptachlor	0.5	0.017	42-132	76-109	17	19
	Aldrin	0.5	0.017	10-148	68-113	24	6
	Dieldrin	1	0.033	17-155	75-111	43	16
	Endrin	1	0.033	33-165	73-127	19	15
	4,4'-DDT	1	0.033	29-143	22-167	36	15
	Aroclor 1254[1]	5	0 167	60-145	55-155	22	32
	Surrogate:						
	DBC	1	0.0333	73-126	56-125	N A	N A
	DCB	0.2	0.013	61-140	86-138	N A	N A
	TCMX	0.2	0.013	35-138	51-127	N A	N A

Table C-4,
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Analytical Method	Spiking Compounds	Spike Concentration: Water (µg/ℓ)	Spike Concentration: Soil/ Sediments (mg/kg)	Laboratory-Established Control Limits: Percent Recovery %: Water	Laboratory-Established Control Limits: Percent Recovery %: Soil/ Sediments	Laboratory-Established Control Limits: Relative Percent Difference (%): Water	Laboratory-Established Control Limits: Relative Percent Difference (%): Soil/ Sediments
8150	Matrix:						
	2,4-D	10	0.33	71-195	7-260	43	149
	2,4-DB	10	0.33	74-195	12-295	43	191
	2,4,5-T	1	0.033	51-170	13-202	65	51
	2,4,5-TP (Silvex)	1	0.033	69-182	70-146	22	37
	Dalapon	12.5	0.83	12-203	12-107	175	217
	Dicamba	1	0.033	50-218	12-250	17	19
	Dichloroprop	10	0.33	57-187	12-198	23	65
	Dinoseb	5	0.167	12-230	D-250[1]	75	200[1]
	MCPA	1,000	33.3	58-120	45-123	25	41
	MCPP	1,000	33.3	47-135	56-116	29	37
	Surrogate:						
	DCAA	10	0.2	15-148	38-136	N/A	N/A
8240	Matrix:						
	1,1-Dichloroethene	50	0.05	61-145	59-172	14	22
	Trichloroethene	50	0.05	71-120	62-137	14	24
	Benzene	50	0.05	76-127	66-142	11	21
	Toluene	50	0.05	76-125	59-139	13	21
	Chlorobenzene	50	0.05	75-130	60-133	13	21
	Surrogates:						
	Toluene-d8	50	0.05	80-122	77-140	N/A	N/A
	Bromofluorobenzene	50	0.05	70-124	62-121	N/A	N/A
	1,2-Dichloroethane-d4	50	0.05	71-128	70-133	N/A	N/A
8270	Matrix:						
	Phenol	75	2.5	12-110	26-90	42	75
	2-Chlorophenol	75	2.5	27-123	25-102	40	50
	1,4-Dichlorobenzene	50	1.7	36-97	28-104	28	27
	n-Nitroso-di-n-propylamine	50	1.7	41-116	41-126	38	28
	1,2,4-Trichlorobenzene	50	1.7	39-98	38-107	28	23
	4-Chloro-3-Methylphenol	75	2.5	23-97	23-97	42	33
	Acenaphthene	50	1.7	46-118	31-137	31	19
	4-Nitrophenol	75	2.5	10-80	11-114	50	50
	2,4-Dinitrotoluene	50	1.7	24-96	28-89	38	47
	Pentachlorophenol	75	2.5	9-103	17-109	50	47
	Pyrene	50	1.7	20-127	35-127	31	36

Table C-4.
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Analytical Method	Spiking Compounds	Spike Concentration: Water ($\mu g/\ell$)	Spike Concentration: Soil/ Sediments (mg/kg)	Laboratory-Established Control Limits: Percent Recovery %: Water	Laboratory-Established Control Limits: Percent Recovery %: Soil/ Sediments	Laboratory-Established Control Limits: Relative Percent Difference (%): Water	Laboratory-Established Control Limits: Relative Percent Difference (%): Soil Sediments
8270 (cont.)	**Surrogates:**						
	Nitrobenzene-d5	50	1.6	27-101	13-107	N/A	N/A
	2-Fluorobiphenyl	50	1.6	13-110	3-110	N/A	N/A
	Terphenyl-d14	50	1.6	38-122	14-202	N/A	N/A
	Phenol-d5	50	1 6	10-152	6-153	N/A	N/A
	2-Fluorophenol	50	1.6	24-112	23-114	N/A	N/A
	2,4,6-Tribromophenol	50	1.6	30-149	26-135	N/A	N/A
		(mg/ℓ)	(mg/kg)				
1311/6010	Arsenic	1.0	N/A	75-113	N/A	NA	N/A
	Barium	20	N/A	70-101	N/A	NA	N/A
	Cadmium	0.2	N/A	64-86	N/A	NA	N/A
	Chromium	1.0	N/A	69-93	N/A	NA	N/A
	Lead	1.0	N/A	56-146	N/A	NA	N/A
	Selenium	0.5	N/A	28-160	N/A	NA	N/A
	Silver	1.0	N/A	ND*-126	N/A	NA	N/A
1311/7470	Mercury	0.04	N/A	72-119	N/A	NA	N/A
1311/8240	**Matrix:**						
	1,1-Dichloroethene	50	N/A	N/A	N/A	N/A	N/A
	Trichloroethene	50	N/A	N/A	N/A	N/A	N/A
	Benzene	50	N/A	N/A	N/A	N/A	N/A
	Surrogates:						
	Toluene-d8	50	N/A	N/A	N/A	N/A	N/A
	Bromofluorobenzene	50	N/A	N/A	N/A	N/A	N/A
	1,2-Dichloroethane-d4	50	N/A	N/A	N/A	N/A	N/A
1311/8270	**Matrix:**						
	1,4-Dichlorobenzene	50	N/A	N/A	N/A	N/A	N/A
	2,4-Dinitrotoluene	50	N/A	N/A	N/A	N/A	N/A
	Pentachlorophenol	75	N/A	N/A	N/A	N/A	N/A
	Surrogates:						
	Nitrobenzene-d5	50	N/A	N/A	N/A	N/A	N/A
	2-Fluorobiphenyl	50	N/A	N/A	N/A	N/A	N/A
	Terphenyl-d14	50	N/A	N/A	N/A	N/A	N/A
	Phenol-d5	50	N/A	N/A	N/A	N/A	N/A
	2-Fluorophenol	50	N/A	N/A	N/A	N/A	N/A
	2,4,6-Tribromophenol	50	N/A	N/A	N/A	N/A	N/A

Notes: (1) Percent recoveries and relative percent difference control criteria are interim control limits pending laboratory acquisition of a minimum number of data points for statistically valid acceptance limits.
(2) Limits for acceptance are to be established pending validation of the use of this compound as a surrogate for this test.
N/A Not applicable
NA Not available
ND* Not Detected - recovery is hindered by the precipitation of silver chloride.

(t) Proper temperature control was not maintained.

No qualifiers will be used for data deemed acceptable.These qualifiers have been adapted from the following EPA publications:

- USEPA Contract Laboratory Program, National Functional Guidelines For Organic Data Review Draft, Multi-Media, Multi-Concentration (OLM01.0) and Low Concentration Water (OLC01.0) (U.S. EPA, 1991);

- USEPA Contract Laboratory Program, National Functional Guidelines For Pesticide/PCB Data Review Draft, Multi-Media, Multi-Concentration (OLM01.0) and Low Concentration Water (OLC01.0) (U.S. EPA, 1991);

- USEPA Hazardous Site Evaluation Division, Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (U.S. EPA 1988a).

7.5 Data Reporting

Final reports from PACE, Inc. will include the following elements:

- A copy of the signed chain-of-custody form showing the date and time the sample was received;

- A cross-reference of field sample number to laboratory sample number;

- A cross-reference to identify applicable laboratory QC samples with the field sample;

- A glossary to define the symbols and terms used in the laboratory report;

- Sample collection, extraction, and analysis dates;

- A list of the instrument, method, and practical quantitation limits;

- Calibration information including initial and continuing calibration;

- A data or analytical results summary for the samples; and

- A QA/QC summary report, providing data on method blanks, surrogate recoveries, laboratory control samples, MS/MSD, or any other QA/QC samples relevant to the sample. The QA/QC report will also detail the laboratory control limits and discuss corrective actions taken when laboratory control limits are exceeded.

8.0 INTERNAL QUALITY CONTROL CHECKS

Sample collection procedures specific to this work effort are detailed in the FSP of this document. QC procedures associated with all sample collection procedures are an integral part of each sampling methodology. These procedures will be oriented to the collection of representative samples that are free of external contamination.

8.1 Field Activities Quality Control

Chain-of-custody forms will accompany all samples. Sampling equipment will be thoroughly cleaned between each sampling event to prevent cross-contamination of the samples. Sampling equipment used to collect samples for volatile organic analysis will not be allowed to come in contact with any type of plastic. Details for decontamination procedures for drilling and sampling equipment are provided in Sections 2.4 and 2.5, respectively, of the FSP. The following paragraphs describe field QA/QC samples that will be collected during the field investigation.

8.1.1 Trip Blanks

Trip blanks will accompany each cooler shipment of samples sent to the laboratory for analysis of volatile organic compounds. Trip blanks are prepared by the laboratory by filling two 40 ml vials with Type II Reagent Grade Water. Trip blanks are transported to the site, handled like a sample, and returned to the laboratory for volatile organic compounds (VOC) analysis. Trip blanks are required for soil and water samples.

8.1.2 Equipment Blanks

One set of equipment blanks will be collected for every day of sampling. Equipment blanks will be analyzed for all parameters noted on the chain-of-custody form for the sampling event associated with that equipment blank. Equipment blanks are prepared by pouring Type II Reagent Grade Water through the sampling device, transferring the water to appropriate sample bottles, and transporting the samples to the laboratory for analysis.

8.1.3 Duplicate Samples

Duplicate water samples will be collected at a frequency of 10 percent to provide a measure of possible sampling method variability. The duplicate samples will consist of two samples collected independently at one sampling location during one act of sampling. Field duplicates will be falsely identified so that laboratory personnel are unable to distinguish them from normal field samples.

8.1.4 Replicate Samples

Replicate soil samples will be collected at a frequency of 10 percent to provide a measure of method variability and/or precision. The replicates will be prepared by cutting the sample core in half with one half submitted as the actual sample and the other half submitted with a fictitious sample number so that laboratory personnel are unable to distinguish the replicate from the normal field samples.

8.2 Laboratory Analysis Quality Control

When samples are received by PACE, Inc., they are batched according to type of analysis and matrix. A QC batch consists of no more than 20 samples. The internal QC measures used by PACE, Inc. are described in the following sections.

8.2.1 Laboratory or Method Blank

PACE, Inc., will use an artificial, matrixless sample to monitor the analytical batch for interferences and contamination from glassware, reagents, and other potential laboratory-generated contaminants. An analytical batch will be those samples that are grouped together with the same method sequence and the same reagent lot and process common to each sample within the same period or in the continuous sequential time periods. The laboratory blank is taken through the entire sample preparation process, and is included with each batch of extractions/digestion preparation or with each 20 samples, whichever is more frequent.

8.2.2 Laboratory Control Sample

The Laboratory Control Samples (LCS), are defined as blank soil or reagent water spiked with a known amount of analyte. The spiking analyte is from a different source than that used to establish the calibration standards. Table C-3 details the control limits for laboratory control samples for the analytical method to be used on samples collected during this work effort.

8.2.3 Matrix Spike/Matrix Spike Duplicates

MS/MSD QC samples will be analyzed with each batch with a frequency of 5 percent or with each different type of sample matrix, whichever is more frequent. Spiked sample results that exceed the control limits described in Table C-4 will be further evaluated under the laboratory data validation procedures described in this QAPP. The matrix spiking solutions for organics are prepared from neat materials, or from sources independent of the calibrations standards. Inorganic matrix spikes are prepared with analytes of interest at an appropriate concentration as specified in SW-846. The specific MS/MSD analytes for organic and inorganic QC samples are detailed in Table C-4.

8.2.4 Surrogate Compounds

For GC and GC/MS analyses, the analytical process includes the addition, subsequent detection, and recovery calculations of surrogate spiking compounds. Surrogate compounds are added to every sample at the beginning of the sample preparation, and the surrogate recovery is used to monitor matrix effects and sample preparation.

Method-specific surrogates are used in both matrix and laboratory control samples to establish the possibility of matrix interference. Suitable surrogates will have the following qualities:

- o Will be compounds not requested for analysis;
- o Are compounds that do not interfere with the measurement of the analytes of interest;
- o Are not naturally occurring, but are chemically similar to the analytes of interest; and
- o Exhibit similar responses as the analytes of interest.

Tables C-3 and C-4 detail the control limits for surrogate spiking compounds to be used by PACE, Inc. in laboratory control, matrix spike/matrix spike duplicate, field duplicate/replicate, blank, and original samples. A summary of internal QC procedures to be used by PACE, Inc is provided in Table C-5.

9.0 PERFORMANCE AND SYSTEMS AUDITS

A QA audit is an independent assessment of the measurement system. The purpose of the performance audit is to qualitatively and quantitatively assess the data generated at any level within the system during the data collection for this work effort. The results of the audit are formulated into a report detailing the overall system performance and deficiencies, plus any recommendations.

9.1 Quality Assurance Audits

The Tetra Tech, Inc. Project QA/QC Manager and/or the QA Auditor will perform the QA performance and systems audits for this work effort. The QA Auditor must be functionally independent of the work effort to ensure objectivity because there will be a requirement for independent assessments of the system and associated data quality. The QA Auditor will be able to identify components of the system which are critical to overall data quality; the QA Auditor should have a technical background and experience that enables an objective and accurate development of audit objectives, design, and interpretation.

Table C-5

Summary of Internal Quality Contr l Procedures

Method	Parameter	QC Performed	Frequency[1]	Acceptance Criteria	Corrective Action
6010 (ICP)	Metals	**Field**			
		Equipment blanks	1 each day of water sampling	≤ 3 x detection limits	No laboratory corrective action required.
		Duplicate field sample	10%	RPD ≤ 30% (W) RPD ≤ 30% (S)	No laboratory corrective action required.
		Laboratory			
		Method blank	5%	3 x Detection limits	1) Investigate. 2) Recalibrate. 3) Reanalyze if appropriate. 4) Redigest samples if reanalysis fails.
		Matrix spike sample	5%	See Table C-4	1) Check calculations. 2) Check reagent spike duplicate samples; if recoveries within limits, flag matrix spike recoveries as attributable to matrix effects.
		Duplicate sample	5%	See Table C-4	Same as matrix spike.
		Laboratory control sample	5%	See Table C-3	1) Investigate. 2) Reanalyze. 3) Evaluate system. 4) Recalculate data and/or reanalyze. 5) Redigest affected samples.

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Table C-5.
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Method	Parameter	QC Performed	Frequency[1]	Acceptance Criteria	Corrective Action
7060 7421 7470/7471 7740 7041 7841	As Pb Hg Se Sb Tl	**Field**			
		Equipment blanks	1 each day of water sampling	≤ 3 x detection limits	No laboratory corrective action required.
		Duplicate field sample	10%	RPD ≤ 30% (W) RPD ≤ 30% (S)	No laboratory corrective action required.
		Laboratory			
		Method blank	1 per batch of 20 samples	≤ 3 x Detection Limit or less	1) Reanalyze if appropriate. 2) Redigest if reanalysis fails
		Matrix spike sample	5%	See Table C-4	1) Evaluate system. 2) Check calculations 3) Check reagent spike, if recoveries within limits, flag MS recoveries as attributable to matrix effects
		Duplicate sample	5%	See Table C-4	Same as MS.
		Laboratory control spike sample	5%	See Table C-3	1) Reanalyze if appropriate. 2) Evaluate system 3) Recalculate data and/or reanalyze 4) Redigest affected samples
8015 Modified (GC/FID)[2]	TPH	**Field**			
		Equipment blank	1 each day of water sampling	< 3 x detection limits	No laboratory corrective action required
		Trip blank (volatile analyses only)	1 per shipment	< 3 x detection limits	No laboratory corrective action required
		Duplicate field sample	10%	RPD < 30% (W) RPD < 30% (S)	No laboratory corrective action required

Table C-5,
Page 3 of 6

Method	Parameter	QC Performed	Frequency[1]	Acceptance Criteria	Corrective Action
8015 Modified (cont.)	TPH	**Laboratory**			
		Method blank	1 per batch of 20 samples	≤ 3 x detection limits	1) Evaluate system; run system blank, or 2) Reanalyze, or 3) Re-extract/reanalyze if necessary.
		System blank	As required	≤detection limits	Run until system is clean.
		Matrix spike sample	5%	See Table C-4	1) Evaluate system. 2) Check calculations. 3) Check reagent spike/reagent spike duplicate; if recoveries within limits, flag MS recoveries as attributable to matrix effects.
		Matrix spike duplicate sample	5%	See Table C-4	Same as MS.
		Surrogate spikes	Every sample, method blank, and standard	See Table C-3, C-4	1) Check calculations. 2) Check reagent spike duplicate; if recoveries within limits, flag MS recoveries as attributable to matrix effects.
		Laboratory control sample	5%	See Table C-3	1) Assess impact on data, or 2) Reanalyze, if necessary, or 3) Recalibrate, or 4) Reanalyze any affected samples, if necessary.
8080 (GC/ECD)	Organochlorine Pesticides and PCBs	**Field**			
		Equipment blank	1 each day of water sampling	≤ 3 x Detection limits	No laboratory corrective action required.
		Duplicate field sample	10%	RPD ≤ 30% (W) RPD ≤ 30% (S)	No laboratory corrective action required.

Table C-6,
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Method	Parameter	QC Performed	Frequency[1]	Acceptance Criteria	Corrective Action
8080 (GC/ECD) (cont.)	Organochlorine Pesticides and PCBs	**Laboratory**			
		Method blank	1 per batch	≤ Detection limits	1) Find source of contamination.
		Matrix spike sample	5%	See Table C-4	1) Evaluate system. 2) Check calculations. 3) Check laboratory control sample; if recoveries within limits, flag MS recoveries as attributable to matrix effects
		Matrix spike duplicate sample	5%	See Table C-4	Same as MS
		Surrogate spikes	Every sample, method blank, and standard	See Table C-3, C-4	1) Check calculations. 2) Reanalyze sample extract 3) If all surrogates out of control, re-extract and reanalyze sample
		Laboratory control sample	5%	See Table C-3	1) Check calculations, or 2) Rerun, or 3) Reprepare and/or reanalyze laboratory control sample and all samples associated with it if appropriate
8240 (GC/MS)	Volatile Organics	**Field**			
		Equipment blank	1 each day of water sampling	≤ 3 x Detection limits	No laboratory corrective action required.
		Trip blank	1 per shipment	<3 x Detection limits	No laboratory corrective action required.
		Duplicate field sample	10%	RPD ≤ 30% (W) RPD ≤ 30% (S)	No laboratory corrective action required

Table C-5,
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Method	Parameter	QC Performed	Frequency[1]	Acceptance Criteria	Corrective Action
8240 (GC/MS) (cont.)	Volatile Organics (cont.)	Laboratory			
		Method blank	1 per batch	≤ Detection limit except for common laboratory contaminants which may be 3 x Detection limit	1) Find source of contamination. 2) Reanalyze blank if appropriate.
		Matrix spike	5%	See Table C-4	1) Evaluate system. 2) Check calculations. 3) Check laboratory control sample; if recoveries within limits, flag MS recoveries as attributable to matrix effects.
		Matrix spike duplicate	5%	See Table C-4	1) Check calculations. 2) Check laboratory control sample; if recoveries within limits, flag MS recoveries as attributable to matrix effects.
		Surrogate spikes	Every sample	See Table C-3, C-4	1) Check calculations. 2) Reanalyze sample extract. 3) If still out of control, flag data as matrix effect.
		Internal standard	Every sample	≤ 0.5 x initial cal. check and ≤ 2 x previous cont. cal. check	1) Reanalyze sample extract 2) If still out of control, flag data as matrix effect.
		Laboratory control sample	5%	See Table C-3	1) Check calculations, or 2) Rerun, or 3) Reprepare and/or analyze method spike and all samples associated with it if appropriate.
8270 (GC/MS)	Semi-volatile Organics	Field			
		Equipment blank	1 each day of water sampling	≤ 3 x Detection limit	No laboratory corrective action required.

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Table C-5,
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Method	Parameter	QC Performed	Frequency[1]	Acceptance Criteria	Corrective Action
8270 (GC/MS) (cont.)	Semi-volatile Organics (cont.)	Duplicate field sample	10%	RPD ≤ 30% (W) RPD ≤ 30% (S)	No laboratory corrective action required.
		Laboratory			
		Method blank (Extraction blank)	1 per batch	≤ Detection limits except for common laboratory contaminants which may be 3 x Detection limit	Run system blank. If system is clean and contaminants are present in sample, re-extract.
		Matrix spike sample	5%	See Table C-4	1) Evaluate system 2) Check calculations 3) Check laboratory control sample, if recoveries within limits, flag MS recoveries as attributable to matrix effects
		Matrix spike duplicate sample	5%	See Table C-4	Same as MS
		Surrogate spikes	Every sample	See Table C-3	1) Check calculations. 2) Reanalyze sample extract 3) If still out of control, re extract and reanalyze sample
		Internal standard	Every sample	≤0.5 x initial cont. cal. check and ≤2 x previous cont. cal check	1) Reanalyze sample extract 3) If still out of control, flag data as matrix effect
		Laboratory control sample	5%	See Table C-3 (Spiking compound recovery ≤ 80%)	1) Check calculations, or 2) Rerun, or 3) Reprepare and/or reanalyze LCS spike and all samples associated with it if appropriate

Note: [1]Frequencies for duplicate samples and field blanks are computed based on the number of samples taken and the number of analyses specified in the Statement of Work.

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9.2 Field Audits

Periodic audits of field activities of both Tetra Tech, Inc. staff and subcontractors will be performed by the Tetra Tech, Inc. QA Auditor or QA staff member. The QA audits will be conducted as soon as possible after a project phase begins. The function of the field QA audit will be to:

- Observe procedures and techniques used in the various measurement efforts, including field sampling and analysis;
- Check and verify that instrument and sampling equipment calibration records are in place;
- Assess the effectiveness of and adherence to the prescribed QA procedures;
- Review document control and chain-of-custody procedures including the completion of the chain-of-custody form;
- Review the completeness of data forms and notebooks;
- Review any nonconformance reporting procedures;
- Identify any weakness in the sampling/analytical approach and techniques; and
- Assess the overall data quality of the various sampling/analytical systems employed at the time of the audit.

Based on the audit results, a Tetra Tech, Inc. QA auditor may, as necessary, initiate corrective action at the project level through the QA/QC Project Manager or the Project Manager. A checklist for relevant components of the audit will be filled out by the QA Auditor during the audit. Examples of the general sampling checklists are shown in Figure C-8. Upon completion of the audit, the QA Auditor will discuss any specific weakness or nonconformances with the field team and make recommendations for corrective actions. An audit report will be prepared to include the relevant checklist and distributed to the Tetra Tech, Inc. QA/QC Project Manager and Project Manager. This report will outline the audit approach and present a summary of results and recommendations. The Program Manager is responsible for responding to any deficiencies.

FIGURE C-8

ENVIRONMENTAL SAMPLING SYSTEMS AUDIT CHECKLIST RICHARDS-GEBAUR AFB

Contract: _____ Date: _____

Site: _____ Auditor: _____

Yes	No	Comments	Operation
			PRESAMPLING OPERATIONS
____	____	_____	1. Sample type? (specify)
____	____	_____	2. Qualified personnel?
____	____	_____	3. Adequate facilities, equipment, and supplies?
____	____	_____	4. Sampling locations properly specified?
____	____	_____	5. Copy of task instructions or QAPP? Revision #_____
____	____	_____	6. Copy of daily sampling schedule?
			SAMPLING OPERATIONS
____	____	_____	1. Samples collected at proper sampling locations?
____	____	_____	2. Rinse probe with DI H_2O prior to placement?
____	____	_____	3. Purge appropriate volume prior to sampling (3 borehole volumes) For this well #____ = _____ gallons
____	____	_____	4. Appropriate sample technique used to obtain representative sample?
____	____	_____	5. Appropriate techniques used to ensure sample integrity and avoid contamination?
____	____	_____	6. At least 10% duplicate samples collected

Yes	No	Comments	Operation
____	____	_____	7. Sufficient volume of sample collected?
____	____	_____	8. Suitable sample container used for storage?
____	____	_____	9. Sample bottles properly labeled?
____	____	_____	10. Sampling data sheet completed in a timely manner? (Within five minutes of activity.)
____	____	_____	11. OVA measurements taken and recorded prior to sampling and every 30 minutes during sampling?
			POST-SAMPLING OPERATIONS
____	____	_____	1. Decontamination performed according to current procedure? (Soap, potable water, Type II, reagent grade water, methanol, hexane.)
____	____	_____	2. Well capped immediately following removal of pump and prior to decontamination?
____	____	_____	3. Sampling date, time, and location properly recorded in logbook?
____	____	_____	4. Suitable sample shipping container label used?
____	____	_____	5. Chain-of-custody form filled out?
____	____	_____	6. Chain-of-custody seal affixed to sample container?
____	____	_____	7. Refrigerated sample storage?
____	____	_____	8. Overall recordkeeping procedure adequate?

Additional comments:

9.3 Laboratory Audits

PACE, Inc. undergoes numerous external and internal audits on a regular basis. The reports of all the audits are provided to the Regional Quality Assurance Officer, Corporate Quality Assurance Officer, Regional Director, and Department Managers who implement appropriate corrective actions.

9.3.1 Tetra Tech Audits

At least once during the project, Tetra Tech, Inc.'s Project QA/QC Manager and/or QA Auditor will visit PACE, Inc. and verify that this QAPP, as well as the appropriate sections of the Handbook, are being adhered to. The audit will occur within the first week of receiving samples to ensure that deficiencies can be corrected early in the project. All relevant components of this QAPP, and the Handbook, and their application to PACE, Inc. analysis of environmental samples collected during this work effort will be reviewed.

9.3.2 Other External Audits

External audits are performed by the following entities at the listed frequencies:

- Kansas Department of Health and Environment (Annual)
- U.S. EPA Contract Laboratory Program (Annual)
- Industrial clients/consultants (per contractual agreements)
- Federal/state agencies - other than those previously specified (per contractual provisions)

9.3.3 Internal Audits

Internal audits are conducted by the PACE Regional Quality Assurance Officer each quarter. The results of the audit are provided to the Corporate Quality Assurance Officer, Regional Director, and Department Managers who implement corrective actions. Corporate Quality Assurance conducts an audit of the regional laboratories either annually or bi-annually dependent upon the findings of the most recent audit and/or report of the Regional Quality Assurance Officer.

9.3.4 Performance Evaluation Check Samples

PACE, Inc. participates in the following external and internal performance evaluation sample programs:

- o EPA Semiannual Drinking Water Performance Check Samples (WS Series);
- o EPA Semiannual Wastewater Performance Check Samples (WP Series);
- o EPA National Pollution Discharge Elimination System (NPDES) DMR-QA;
- o EPA Contract Laboratory Program (CLP) Organics Samples (QB Series);
- o State of California - Wastewater (WW)/Solid and Hazardous Waste;
- o State of Kansas Department of Health & Environment - WS, WP, and Hazardous Waste;
- o State of Michigan - Drinking Water (DW);
- o State of North Dakota - DW/WW/Solid and Hazardous Waste;
- o State of Oklahoma - DW/WW/Solid and Hazardous Waste;
- o PACE Internal Testing Services (PITS);
- o Kansas Regional Laboratory Internal QC (Environmental Resource Associates, Colorado); and
- o Client requested performance evaluation tests.

9.3.5 Certification Programs

PACE, Inc. is approved by the U.S. EPA Contract Laboratory Program (CLP) to perform EPA Level IV analysis of environmental samples.

PACE, Inc. is certified by the following state and federal agencies:

- o State of California Department of Health Services Environmental Laboratory Accreditation Program (ELAP) - for drinking water, wastewater, and hazardous waste testing;
- o State of Colorado (pending) - for drinking water testing;
- o State of Iowa Department of Natural Resources (pending) - for drinking water testing;
- o State of Kansas Department of Health and Environment - for drinking water, wastewater, and solid and hazardous waste testing;

- o State of Oklahoma - for solid and hazardous waste testing;
- o State of Michigan - for drinking water testing; and
- o State of North Dakota - for drinking water, wastewater, and solid and hazardous waste testing.

10.0 PREVENTIVE MAINTENANCE

10.1 Maintenance Responsibilities

PACE, Inc. maintains service contracts for most major analytical instruments including chromatographs, balances, and atomic absorption spectrophotometers. All instruments and equipment receive routine preventive maintenance, which is recorded in instrument specific maintenance logs. Routine maintenance ensures that the equipment is operating under optimum conditions, reducing the possibility of instrument malfunction.

10.2 Maintenance Schedules

Preventive maintenance procedures including lubrication, source cleaning, detector cleaning, and the frequency of such maintenance are performed according to the procedures recommended in the manufacturer's instrument user manual.

Chromatographic carrier gas purification traps, injector liners, and injector septa are cleaned or replaced on a regular basis. Precision and accuracy data are examined for trends and excursions beyond control limits as evidence of instrument malfunction. Maintenance must be performed when the instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decreased sensitivity, or failure to meet one or another of the quality control criteria. Instrument logbooks containing maintenance and repair records are kept in the laboratories at all times.

10.3 Spare Parts

The laboratories also maintain adequate supplies of spare parts such as GC columns, syringes, septa, injection port liners, and electronic parts to minimize potential down-time.

In the event of equipment malfunction that cannot be readily resolved by laboratory personnel, service is obtained from the instrument vendor or manufacturer. Should instrument failure preclude completion of analyses within contract requirements (i.e., holding times), PACE, Inc. will contact Tetra Tech to determine alternative strategies.

11.0 PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The two aspects of data quality of primary concern to Tetra Tech, Inc.'s data validation staff are precision and accuracy. Precision is a measure of mutual agreement among individual measurements of the same property under prescribed similar conditions. Accuracy reflects the degree to which the measured value represents the actual or "true" value for a given parameter among individual measurements of the same property under prescribed similar conditions. The completeness of the data will be evaluated based upon the percentage of valid data relative to the total tests requested. How these data quality parameters are assessed by PACE, Inc. Quality Assurance staff, as well as Tetra Tech, Inc.'s data validation staff, is discussed in Section 7.0 of this QAPP.

Laboratory-established criteria for evaluating the precision and accuracy of the data are presented in Table C-3 for the laboratory control samples and surrogates. Table C-4 details the MS/MSD and surrogate QC limits. Percent recovery and relative percent difference control limits for each method, matrix, and spiking compound are also described in these two tables. Table C-4 also contains the concentrations of spiking analytes.

12.0 CORRECTIVE ACTION

12.1 Field Activities

During this work effort at Richards-Gebaur AFB, the Tetra Tech, Inc. Project Manager and sampling team members will be responsible for ensuring that all procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. If a problem arises, prompt action will be taken to correct it. Engineering and scientific calculations will be checked and corrected as required by technical personnel, and will not, as a rule, require QA reporting.

A nonconformance exists if there is a deviation from or a noncompliance with contract specifications, approved procedures, the FSP, QAPP, Work Plan, or the Handbook. Nonconformance also includes major errors in documented analysis, data, or results, and deficiencies in documentation of any other aspect of the project that may affect the quality of the results. Personnel who identify a nonconformance shall immediately report both verbally and in a written report the condition to the Tetra Tech, Inc. Project QA/QC Manager who will review the report. The Nonconformance Report, when a nonconformance event occurs, is displayed in Figure C-9. The sample numbers of any samples affected by the nonconformance should be described in Part 1 of the Nonconformance Report. The Project QA/QC Manager or QA Auditor will evaluate the nonconformance and complete Part 2 of the Nonconformance Report. Based on an evaluation of the nonconformance, the following activities will result:

- Work on the specific task will stop and corrective actions will be taken; or

Project No _____ Project Location _____ NCR No. _____

Nonconformance Report (NCR)

Project: _____ Project No. _____

Activity _____ Location _____

Part 1

Description of nonconformance

_____

_____

_____

Personnel reporting nonconformance _____ Date _____

Part 2

Evaluation of nonconformance

Significant condition adverse to quality Yes_____ No_____

Work stoppage required Yes_____ No_____ Impacts previous data/reports Yes_____ No_____

Remarks _____

_____

Evaluated by _____ Date _____ Title _____

Approved by _____ Date _____ _____ Date _____
Project Mgr. Project QA/QC Officer

Part 3

Recommended corrective action/disposition _____

_____

_____

Recommended by _____ Date _____ Title _____

Approved by _____ Date _____ _____ Date _____
Project Mgr Project QA/QC Officer

Part 4

Corrective action/disposition completed by: _____ Date _____

Remarks _____

_____

Corrective action approved and NCR closed by:

Approved by _____ Date _____ _____ Date _____
Project Mgr Project QA/QC Officer

Figure C-9: Nonconformance Report Form

- If the nonconformance involves a major deviation from the contract or client-approved Work Plan or Sampling and Analysis Plan which may adversely affect the cost schedule of the work, the client will be notified of the nonconformance; or

- If the nonconformance has adversely affected previously gathered data, the Tetra Tech, Inc. Project Manager will complete Part 2 of the Nonconformance Report and notify in writing all individuals and organizations that may be affected by the nonconformance and resulting data.

The Tetra Tech, Inc. Task Manager may recommend corrective action to resolve the nonconformance and complete Part 3 of the Nonconformance Report. As the corrective action is implemented and completed, the action will be reviewed and approved by the Tetra Tech, Inc. Project Manager and Project QA/QC Manager, and Part 4 of the Nonconformance Report will be completed. In addition, a system for issuing a formal Quality Deficiency Notice will be established to address problems identified through independent QA audits. Figure C-10 represents an example of a Quality Deficiency Notice. Each Quality Deficiency Notice will address a specific problem or deficiency, usually identified during the QA audit of laboratory or project operations. Any Quality Deficiency Notice issued along with the corresponding responses will be tracked. If there is no satisfactory response to a Quality Deficiency Notice within a 30-day time frame, or if there is a dispute concerning the corrective action, the recommendation and/or conflict will be referred to successively higher management levels until the issue is resolved.

12.2 Laboratory Activities

The type and level of corrective action for laboratory activities will depend on the degree of nonconformity. If, as a result of an audit or QC sample analyses, a systems defect is discovered, corrective action is implemented. The Project Manager, Department Manager, Quality Assurance Officer, Supervisor, or Laboratory Director may initiate the action and will participate in the corrective action. If previously reported data are affected by a situation requiring correction or if the corrective action impacts a project budget or schedule, the matter will be acted upon by the Project Manager, Department Manager, Quality Assurance Officer, and Regional Director.

The steps comprising a closed-loop corrective action system are as follows:

- Define the problem.

- Assign responsibilities for problem investigation.

- Investigate and identify the cause of the problem.

- Check all calculations.

Quality Deficiency Notice

1. QDN number _____
2. Project _____ 3. Project Number _____
4. Activity _____ 5. Location _____
6. Controlling document _____
7. Requirement _____

8. Description of Deficiency _____

9. Reported by _____ 10. Date _____
11. Discussed with _____ 12. Date _____

Response:

13. This section to be completed by responsible organization and returned to Tetra Tech, Inc. QA by _____ (Date).
14. Corrective action (including action to prevent recurrence and root cause determination).

15. Scheduled completion date _____ 16. Signed _____ Date _____

Page 1 of 2

United States Air Force

Quality Deficiency Notice
(page 1 of 2)

Figure
C-10

Quality Deficiency Notice

Evaluation of response: QDN number _____

17. This section to be completed by quality assurance department

First response ☐ Satisfactory ☐ Unsatisfactory

Remarks _____

_____ Evaluated by _____ Date _____

Second response ☐ Satisfactory ☐ Unsatisfactory

Remarks _____

_____ Evaluated by _____ Date _____

Third response ☐ Satisfactory ☐ Unsatisfactory

Remarks _____

_____ Evaluated by _____ Date _____

18. Corrective action verified ☐ Yes ☐ N/A

Remarks _____

_____

_____

_____

_____

Verified by _____ Date _____

19. Quality deficiency notice closed on _____

By _____

Page 2 of 2

United States Air Force

Quality Deficiency Notice
(page 2 of 2)

Figure
C-10

- o Re-analyze the sample.
- o Verify the integrity of the spiking solution, laboratory control sample, or calibration standard.
- o Check instrument and operating conditions to preclude the possibility of malfunctions or operator error.
- o Determine the corrective action(s) necessary to eliminate the problem.
- o Assign and accept responsibilities for implementing the corrective action.
- o Establish the effectiveness of the corrective action and implement the correction.
- o Verify and document that the corrective action has eliminated the problem (using a Discrepancy Report form, Figure C-3).

Recommended holding times for samples are monitored closely. If a sample is unintentionally analyzed outside a holding time, a Discrepancy Report will be filled out (Figure C-3). The Laboratory Manager will immediately notify Tetra Tech, Inc.'s Project Manager and Project QA/QC Officer of the holding time violation by phone, followed up by a hard-copy of the completed Holding Time Violation Notification Form by both FAX and first-class mail. Samples shall be resampled if holding times are exceeded prior to either extraction or analysis of the environmental sample.

13.0 QUALITY ASSURANCE REPORTS

Effective management of a field sampling and analytical effort requires timely assessment and review of field and laboratory activities. Such assessment and review will require effective interaction and feedback between Tetra Tech, Inc.'s field sampling team, the Project Manager, the Project QA/QC Manager, and the QA Officers of PACE, Inc. Specific report procedures and contents are summarized below.

Sampling and analytical field operations will be reviewed by staff members responsible for the activity to determine if the sampling QC requirements are being fulfilled. PACE, Inc. QA staff are responsible for keeping Tetra Tech, Inc.'s Project QA/QC Manager and Project Manager up to date regarding the status of their respective tasks. This procedure ensures that solutions are developed and implemented as quickly as possible.

The QA Auditor will include the following elements in a report detailing the status of the system data quality:

- o Activities and general program status;
- o Calibration and QC problems;
- o Unscheduled maintenance activities;
- o Corrective action activities;
- o Status of any unresolved problems;
- o Assessment and summary of data completeness; and
- o Significant QA/QC problems and recommended and/or implemented solutions.

The QA Auditor will prepare audit reports following each performance and system audit. These reports will address the audit results and provide a qualitative assessment of overall system performance. They will be submitted to the QA Officer and the Laboratory Manager, and to Tetra Tech, Inc.'s QA/QC Program Manager, the Laboratory QA Oversight Staff Member, QA/QC Project Manager, and the Project Manager.

Final QA/QC reports will contain an analysis of the QA/QC used to assess the quality of data generated during both field and laboratory operations. The purpose of the final report is to allow evaluation of whether data quality objectives stated in Section 3.0 of this document have been met or not. Based on these results, usability of the data for human health and ecological risk assessment purposes can be evaluated.

If problems requiring swift resolution arise, the Tetra Tech, Inc. Program Manager will be informed and the nonconformance reporting/corrective actions discussed in Section 12.0 of this document will be implemented.

APPENDICES

APPENDIX C-1

SAMPLE RECEIPT AND CHECK-IN SOP

STANDARD OPERATING PROCEDURE

Sample Receipt And Check-In

SOP NUMBER ALL-Q-004-A

AUTHOR Sue Lautt

EFFECTIVE DATE April 27, 1992

SUPERSEDES

APPROVAL

Rodney T. Miller — 5-4-92

Corporate Quality Assurance Officer — Date

Roger P. Johnson — 5/29/92

Vice President, Quality/Technical Services — Date

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SAMPLE RECEIPT AND CHECK-IN

I. PURPOSE

A. The purpose of this Standard Operating Procedure (SOP) is to establish a uniform and efficient system for the receipt of samples into the laboratory.

II. APPLICATION

A. The policies and procedures contained in this SOP are applicable to all Sample Custodians and Check-In personnel of PACE, Incorporated.

III. RESPONSIBILITIES

A. QUALITY ASSURANCE OFFICER (QAO)

1. The QAO will provide copies of this SOP to the Sample Custodians, receiving personnel, and any other personnel involved in sample receipt and check-in.

B. SAMPLE CUSTODIAN/RECEIVING PERSONNEL

1. Responsible for adhering to the policies and procedures set forth in this SOP.

2. Responsible for recommending revisions to the SOP to the Client Services manager via written memo as required to maintain an efficient and reliable operation.

C. CLIENT SERVICES MANAGER

1. Responsible for ensuring implementation and adherence to this SOP.

2. Responsible for performing an annual review of this SOP and reporting all required revisions in writing to the QAO.

D. PROJECT MANAGER

1. Responsible for contacting the EPA Sample Management Office (SMO) or when applicable other non-EPA clients if discrepancies occur at the time of sample receipt (e.g., custody seals, chain of custody records, traffic reports, airbills or sample tags absent, poor sample conditions, or disagreement among documentation received with samples).

IV. REVIEWS/REVISIONS

A. This SOP will be reviewed and/or revised on an annual basis at a minimum by the QAO.

V. DISTRIBUTION

A. This SOP will be distributed by the QAO to the Sample Custodian(s) and all other personnel involved in sample receipt and check-in.

VI. GENERAL POLICIES

A. The following procedures are applicable to the sample receiving and check-in functions occurring on any shift of any calendar day. (Seven days per week, 24 hours per day).

B. Proposals should be entered into the LDMS auto-invoicing system before a sample is logged in. If a (generic or non-generic) proposal is not on the LDMS system for the specified client, the standard price list will be utilized by the system.

VII. PROCEDURES

A. ROUTINE SAMPLE RECEIPT

1. The sample custodian will examine the shipping container and record any damage incurred through shipping. Any damage will be recorded on a Sample Condition Upon Receipt (SCUR) form. An example of this form is included as Attachment 1.

   a. The SCUR may be generated by entering the required information into the Laboratory Data Management System (LDMS). The LDMS will bring up the screen for the SCUR immediately after the samples are entered and will prompt the user in completing the form.

2. The sample custodian opens the shipping container under a fumehood, removes the enclosed sample documents, examines sample containers, and records "yes" or "no" answers to the questions on the SCUR. Any items answered "no" must be explained in the space provided. The cooler temperature upon receipt is noted (4° +/- 2° C - acceptance range) and when applicable, samples preserved via pH adjustment are tested with wide range pH paper to verify that acceptable stablization was achieved (pH < 2 or pH > 12). Notify the PACE project manager if non-compliance is observed.

3. Compare the Chain of Custody (COC) records (see Attachment 2) with the shipment received to verify agreement. If discrepancies are found, contact the PACE Project Manager immediately. If the Project Manager is not available, contact the QAO for further direction. A discrepancy report (see SOP Discrepancy Reports) must also be completed.

4. If all samples recorded on the COC records are received by the laboratory and there are no discrepancies observed with the sample shipment, the sample custodian or the check-in personnel will sign the "Accepted by" box on the COC record (Attachment 2). If problems are noted, personnel are directed to sign for the shipment and note the problems in the remarks or additional comments box, or reference the SCUR form detailing the problem(s).

5. Enter sample information into the LDMS as outlined in the LDMS User's Manual, "Project & Sample Data Entry" section. After entry of sample information into the LDMS, a Sample and Analysis Data Entry Form (SADEF - Attachment 3) will be generated providing all information entered into the LDMS for the project.

6. Route all paperwork, including the Sample and Analysis Data Entry Form to the project manager. A copy of the SADEF is mailed to the client for confirmation.

7. A master file containing copies of all SADEFs generated will be maintained in the Login Department.

B. CONTRACT LABORATORY PROGRAM (CLP) SAMPLE RECEIPT

1. The sample custodian or check-in personnel will examine the shipping container and record the following information: The form DC-1 (Attachment 4) will be completed as per the instructions found in the latest revision of the CLP Statement of Work (SOW). One form per CLP case will be used.

   a. Presence/absence of custody seal(s) on the shipping container(s)

   b. Condition of custody seal (i.e. intact, broken)

c. Custody seal numbers, when present

d. Presence/absence of airbills or airbill stickers

e. Airbill or airbill sticker numbers

2. The sample custodian will open the shipping container under a fumehood, remove the enclosed sample documents, and record on form DC-1.

a. Cooler temperature upon receipt (4° +/- 2° C - acceptance range)

b. Presence/absence of EPA custody records

c. Presence/absence of EPA Traffic Reports or Special Analytical Services (SAS) Packing List

d. Condition of sample containers (intact, broken, leaking)

e. Presence/absence of sample tags

f. Sample tag identification numbers (listed/not listed on Chain of Custody form)

(1) If sample tags are present:

a. Record the sample tag document control numbers in the column provided.

b. Compare sample tag document control numbers with the COC record(s). If tag numbers are listed, do they match the sample tag numbers received?

Document any discrepancy between tag numbers received and those listed on the COC record in the "remarks" column.

c. Compare the sample identification noted on the tag with the identification noted on the bottle label. Document any discrepancy between the sample tag and bottle label in the "remarks" column.

d. If sample tag numbers are not listed on the COC record, record this fact in the "remarks" column.

(2) If sample tags are missing proceed to 3 below.

g. Verification of agreement or disagreement of information recorded on receiving documents (i.e., traffic reports, SAS packing lists), sample containers, sample tags, airbills or bills of lading.

h. Date and time received by laboratory, along with initials of person completing form DC-1.

3. If any disagreement of information is found on the receiving documents (see VII B.2.g), contact the Project Manager (PM) or the QAO immediately. The PM or QAO will contact the EPA Sample Management Office (SMO), (i.e., Viar), for clarification and notify the appropriate laboratory personnel.

4. The telephone contact with SMO shall be documented by the person making contact via a CLP Telephone Contact Log provided by SMO-Viar and Company (see Attachment 5). Document the problem(s) and resolution(s).

5. If all samples recorded on the COC record were received by the lab and there are no problems observed with the sample shipment, the sample custodian or check-in personnel will sign the "Accepted by" box on the COC record. If problems are noted, the custodian will sign for the shipment and note any problems in the "remarks" or additional comments box, or reference form DC-1 detailing the problem(s). The sample custodian or check-in personnel will also sign and date the SAS packing lists, traffic reports and airbills, if present.

6. Enter sample information into the LDMS in accordance with the LDMS User's Manual, (see A5 of this SOP).

7. Route all paperwork to the project manager.

C. LDMS AUTO-INVOICING

1. Enter the proposal number if provided by the project manager.

   a. If proposal number is not known or needs verification, check proposal list. Press PF10, Lookup proposal.

   b. Search Proposal List by:

      (1) Proposal number - PF3
      (2) Proposal name - PF5
      (3) Proposal by Client Number - PF7
      (4) Proposal by Client Name - PF9

   c. Select one and fill in blanks. Press appropriate PF key.

   d. Proposal will be listed on screen by selection.

e. Selection spaces will be located in bottom left hand corner. Select proposal by entering selection numbers.

(1) PF2-SELECT PROPOSAL - Assigns proposal with project being checked into LDMS

(2) PF3-DISPLAY PROPOSAL - Displays specific information contained in the proposal

(3) Other PF keys move you through the proposal list.

f. After selection is made, press appropriate PF key. If PF2 is selected, proposal will now appear in Proposal number blank on Project Add screen. If PF3 is selected, proposal will be displayed. Pressing Enter will select proposal number. User may exit without selecting.

VIII. REFERENCES

A. Contract Lab Program (CLP) Statement of Work for Organic and Inorganic Analyses, 3/90 Revision

B. USEPA CLP User's Guide, 12/88 Revision

C. PACE, Inc. LDMS User's Manual, current revision

ATTACHMENT 1
SCUR

SAMPLE CONDITION UPON RECEIPT CHECKLIST

Client:_____ Project #:_____

Date Received:_____

Complete this checklist (A) during sample receipt. If any items are marked NO, the bottom of this form (B) must also be completed. Otherwise, proceed with check-in of samples.

Section A

YES NO 1. Is a chain of custody (COC) or documentation containing information normally contained on a COC present?

YES NO 2. Is the date and time relinquished in agreement with that written on the letter or COC?

YES NO 3. Do the samples received agree with the COC or accompanying paperwork (i.e. number of samples, matrices, sample tags, sample containers, analyses, etc.)?

YES NO 4. Are all the samples within the holding times for requested analysis? Communicate any lapse of greater than 4 days beyond date of collection for VOA analysis.

YES NO 5. Are the sample containers intact (i.e., not broken leaking, etc.)?

YES NO 6. Are the samples at the proper temperature? Temp.in C°_____

YES NO 7. Is there sufficient sample quantity to perform all requested analyses?

YES NO 8. Are the samples preserved correctly?

YES NO 9 Are the VOA vials head-space free?

Section B

Explain NO items here: _____

_____

_____

SAMPLE RECEIPT AND CHECK-IN

ALL-Q-004-A

File Name: HPPCRSOP3

Date: April 27, 1992

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ATTACHMENT 2
COC

pace
INCORPORATED
THE ASSURANCE OF QUALITY

44808

CHAIN-OF-CUSTODY RECORD
Analytical Request

74 250

Client

Address

Phone

Report To:

Bill To:

P.O. # / Billing Reference

Project Name / No.

Pace Client No.

Pace Project Manager

Pace Project No.

*Requested Due Date:

Sampled By (PRINT):

Sampler Signature

Date Sampled

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H_2SO_4	HNO$_3$	VOA			ANALYSES REQUEST	REMARKS
1													
2													
3													
4													
5													
6													
7													
8													

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT / DATE	SHIPMENT METHOD RETURNED / DATE

Additional Comments

ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME

ORIGINAL

SEE REVERSE SIDE FOR INSTRUCTIONS

ATTACHMENT 3

SADEF

DATE: 10/31/91
10:08 AM

P A C E
MINNESOTA REGION

PAGE: 1

Sample and Analysis Data Entry Form - Modified Sample(s)

PACE, Inc. : Client No : 000023
Mr. Steve Crupi : Client Contact
1710 Douglas Drive North : Address
Minneapolis, MN. 55422

612-544-5543 : Telephone No

Project No: 911031.504 Due Date: 12/05/91 Client P.O. No:
Project Manager: KJR Project Name: 17292
Manager's Name: Karen J. Reilly
Project Type: A Analytical
QC Level: A Report Style: S
Desc:

Sample No: 10 038825.4 Collected Date: 0/00/00 Collected By: CLIENT
Lab Rec'd Date: 10/30/91 Checked-In By: DRF Priority: 4
Due Date: 11/28/91 Sample Desc: 3399 0022418
Bottle Types: GV
Comnt: EPA PE SAMPLES GV IS A AMPULE SRC HAS SAMPLES Matrix: LIQUID
Analysis Abbr: Name:
V0A390-L VOLATILES IN WATER - 3/90 CLP LIST

Sample No: 10 038826.2 Collected Date: 0/00/00 Collected By: CLIENT
Lab Rec'd Date: 10/30/91 Checked-In By: DRF Priority: 4
Due Date: 11/28/91 Sample Desc: 3399 0022422
Bottle Types: GV
Comnt: EPA PE SAMPLES GV IS A AMPULE SRC HAS SAMPLES Matrix: LIQUID
Analysis Abbr: Name:
V0A390-L VOLATILES IN WATER - 3/90 CLP LIST

Sample No: 10 038827.0 Collected Date: 0/00/00 Collected By: CLIENT
Lab Rec'd Date: 10/30/91 Checked-In By: DRF Priority: 4
Due Date: 11/28/91 Sample Desc: 3399 0001549
Bottle Types: GM
Comnt: EPA PE SAMPLES GM IS A AMPULE SRC HAS SAMPLES Matrix: LIQUID
Analysis Abbr: Name:
BNA390-L SEMIVOLATILES IN WATER - 3/90 CLP LIST

Sample No: 10 038829.7 Collected Date: 0/00/00 Collected By: CLIENT
Lab Rec'd Date: 10/30/91 Checked-In By: DRF Priority: 4
Due Date: 11/28/91 Sample Desc: 3399 0003690
Bottle Types: GM
Comnt: EPA PE SAMPLES GM IS A AMPULE SRC HAS SAMPLES Matrix: LIQUID
Analysis Abbr: Name:
BNA390-L SEMIVOLATILES IN WATER - 3/90 CLP LIST

PACE, Inc. reserves the right to return all samples at its discretion.

ATTACHMENT 4

DC-1

SAMPLE LOG-IN SHEET

Lab Name: _____ Page ____ of ____

Received By (Print Name): _____ Log-in Date: _____

Received By (Signature): _____

Case Number: _____

Sample Delivery Group No.: _____

SAS Number: _____

REMARKS:

1. Custody Seal(s) Present/Absent* Intact/Broken
2. Custody Seal Nos.: _____ _____
3. Chain-of-Custody Records Present/Absent*
4. Traffic Reports or Packing List Present/Absent*
5. Airbill Airbill/Sticker Present/Absent*
6. Airbill No.: _____ _____
7. Sample Tags Present/Absent*
   Sample Tag Numbers Listed/Not Listed on Chain-of-Custody
8. Sample Condition: Intact/Broken*/ Leaking
9. Does information on custody records, traffic reports, and sample tags agree? Yes/No*
10. Date Received at Lab: _____
11. Time Received: _____

Sample Transfer

Fraction: _____ _____

Area #: _____ _____

By: _____ _____

On: _____ _____

	CORRESPONDING		
EPA SAMPLE #	SAMPLE TAG #	ASSIGNED LAB #	REMARKS: CONDITION OF SAMPLE SHIPMENT, ETC.

* Contact SMO and attach record of resolution

Reviewed By: _____

Date: _____

Logbook No.: _____

Logbook Page No: _____

ATTACHMENT 5

Telephone Log

In Reference to Case No(s).:

Contract Laboratory Program
REGIONAL/LABORATORY COMMUNICATION SYSTEM
Telephone Record Log

Date of Call: _____

Laboratory Name: _____
Lab Contact: _____

Region: _____
Regional Contact: _____

Call Initiated By: ____ Laboratory ____ Region

In reference to data for the following sample number(s):

_____
_____
_____

Summary of Questions/Issues Discussed:

_____
_____
_____
_____
_____
_____
_____

Summary of Resolutions:

_____
_____
_____
_____
_____
_____
_____
_____

_____ _____
Signature Date

Distribution: (1) Lab Copy, (2) Region Copy, (3) SMO Copy

APPENDIX C-2

DISCREPANCY REPORTS SOP

STANDARD OPERATING PROCEDURE

Discrepancy Reports

SOP NUMBER	ALL-Q-008-B
AUTHOR	Joe Novotny
EFFECTIVE DATE	August 12, 1992
SUPERSEDES	ALL-Q-008-A

APPROVAL

Don Wright — 8/12/92

Donald C. Wright, Ph.D.
Quality Assurance Officer
PACE - Kansas

Date

D L Boline — 8/17/92

Duane R. Boline, Ph. D.
Regional Director
PACE - Kansas

Date

I. PURPOSE

A. The purpose of this Standard Operating Procedure (SOP) is to provide a detailed explanation of the procedure used to prepare, distribute, and act upon discrepancy reports.

II. APPLICATION

A. The policies and procedures contained in this SOP are to be applied when discrepancies arise during the course of sampling, receipt, analysis, reporting, or other laboratory and field activities.

III. GENERAL POLICIES

A. The Quality Assurance Office will maintain records of discrepancy reports.

B. A discrepancy is an error, divergence or situation for which the corrective action is not defined in the analysis method or laboratory SOP. Examples are provided in Section VII 2. b.

C. All discrepancies must be documented with discrepancy reports so that corrective actions can be taken to prevent any future occurrences.

D. All discrepancy reports will be reviewed on a twice monthly basis by a designated discrepancy quality performance team (QPT; see Section VI. E.) or Quality Assurance Officer.

IV. RESPONSIBILITY

A. PERSONNEL

1. The individual encountering the discrepancy will be responsible for initiating the Discrepancy Report (DR)

and assuring that the information provided in the DR is complete and thorough.

2. The initiator will be responsible for routing the DR to the department supervisor/manager as soon as the initiator's portion of the DR has been completed.

B. SECTION SUPERVISORS, DEPARTMENT MANAGER, DIVISION DIRECTOR

1. These individuals are responsible for assuring that appropriate corrective action items are taken and documented.

2. The section supervisors, department managers, division directors are responsible for routing the DR to the project manager (PM) immediately after initiating the DR.

C. QUALITY ASSURANCE OFFICER (QAO)

1. The QAO is responsible for maintaining DR records.

2. The QAO is responsible for annual review and/or revision of this SOP.

3. The QAO is responsible for distribution of this SOP.

D. PROJECT MANAGER (PM)

1. The PM is responsible for reviewing and completing the DR and returning it to the Quality Assurance Officer.

2. The project manager is responsible for contacting the client if necessary for appropriate corrective action.

E. DISCREPANCY QUALITY PERFORMANCE TEAM QPT

1. A Discrepancy QPT may be assigned at the discretion of the region. Larger regions may assign a QPT due to the volume of samples received and, in turn, the increased number of possible discrepancies encountered.

2. The Discrepancy QPT will consist of members representing various areas of the region. The areas represented may include Field Services, Industrial Hygiene, Sample Check-in, Client Services, Organic Chemistry, Inorganic Chemistry, Quality Assurance and any other area involved in the generation or resolution of discrepancies.

3. Representatives usually participate on the Discrepancy QPT for a six month period. Reappointment will be an option.

4. Representatives are appointed by the Quality Assurance Officer with input from the department managers.

5. The Discrepancy QPT is responsible for identifying problem areas and providing recommendations to prevent the reoccurrence of similar discrepancies.

6. The Discrepancy QPT will be responsible for ensuring that discrepancies are addressed and brought to closure.

7. The Discrepancy QPT is responsible for preparation and distribution of DR summary reports.

V. DISTRIBUTION

A. This SOP will be distributed to all field and analytical personnel.

VI. REVIEW PROCESS AND REVISIONS

A. This SOP will be reviewed annually at a minimum by the Quality Assurance Officer or support personnel.

B. As required, revisions will be made at the time of review by the Quality Assurance Office.

C. Suggestions ~~or recommendations~~ for revisions to this SOP will be directed by written memo to the Quality Assurance Officer.

D. Initial approval for this SOP will be made by the Quality Assurance Officer or support personnel. Final approval for this SOP will be made by the Regional Director.

VII. PROCEDURE

A. RESOURCES

1. Attachment 1: Sample Preservation Discrepancy Report

   a. This attachment is representative of the form to be used when the discrepancy involves a problem in the preservation of samples (as indicated by pH level).

   b. Unless a separate report for preservation of discrepancies is specifically required for a project, preservation discrepancies may be addressed using the Discrepancy Report Form described in Section VII. 2.

2. Attachment 2: Discrepancy Report Form

   a. This form is representative of the form to be used for all discrepancies other than those

listed in Section VII. A. 1. Broken sample containers, receipt of a different quantity of samples than anticipated, samples received on days other than those anticipated, analytical problems, reporting problems, sampling problems, scheduling problems, and other occurrences that require notification of the project manager need to be documented.

b. A discrepancy code will be applied to the report in the space provided. The codes are available on the reverse side of the Discrepancy Report Form. Typical codes follow:

1) Holding Time Violation (lab delay)
2) Lost Samples
3) Preservation
4) Sample Volume
5) Lab Accident
6) Contamination
7) QC Outlier
8) Spiking Error
9) Sample Matrix
10) Miscellaneous
11) Holding Time Violation (client delay)

Note: Codes are assigned on a regionally specific basis.

3. Regions may, at the discretion of the QAO or regional director, use other types of report forms specific to various departments/activities.

B. DESCRIPTION OF PROCEDURE

1. Sample Preservation Discrepancies

a. Laboratory personnel responsible for checking sample pH will record the information requested on the form (see Attachment 1) for any sample which is not properly preserved according to the requirements for sample preservation provided in EPA 40 CFR Part 136. Improper preservation is indicated by atypical pH levels.

2. Other Discrepancies

a. As soon as possible, (preferrably within one hour) following the discovery of a discrepancy, the Discrepancy Report (DR) will be completed as fully as possible by the person first encountering the discrepancy. The initiator placing the DR should make an attempt to determine that the SOP or method has been reviewed for the instructions on corrective actions.

b. Upon preliminary completion of the DR, the Initiator will obtain a DR number from the Quality Assurance Office. If there are problems associated with obtaining a number, contact the Quality Assurance Officer or department manager.

c. The initiator will route the DR to his or her department manager or supervisor. If appropriate corrective action has not been taken, the manager and initiator will discuss, decide upon and take

corrective action. The SOP and method should be consulted for corrective actions.

d. The department manager/supervisor will initial the DR in the space provided after appropriate corrective action has been taken.

e. The DR will then be routed to the PM as soon as possible (preferrably within one hour of completion).

f. The Project Manager will review the form. The review will include an information completeness check, assurance that the discrepancy is explained adequately, and review of any corrective actions if applicable.

(1) The Project Manager will assure that appropriate corrective action is taken.

(a) Appropriate corrective actions may include client contact by the PM. All PM comments should be recorded along with client comments.

(b) In order to assure that corrective action is appropriate, all involved parties will work together to determine the cause and resolution of discrepancies.

(2) The Project Manager will complete his portion of the form and route the completed form to the Quality Assurance Officer.

(a) The PM will communicate with the initiator the proposed corrective action as soon as the action is determined.

(3) The Quality Assurance Officer will archive the forms.

(a) The archives of discrepancy reports will be maintained for a period of 1 year.

(4) Due to the larger potential number of discrepancies encountered in the larger regions, the Discrepancy QPT will prepare a monthly or quarterly discrepancy report summary and distribute this summary to department managers, the Regional Director, and Corporate QA. This will summarize the numbers and types of discrepancies encountered and be used as an aid in tracking and resolving common discrepancies.

VIII. REFERENCES

A. U.S. EPA, *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under Clean Water Act*, 40 CFR Part 136, October 26, 1984.

Attachment 1 Initials Date

Initiator: _____ _____

PM: _____ _____

QA: _____ _____

Sample Preservation Discrepancy

Sample #	Project #	Analysis	Date Analyzed	Client	pH	P.M.

74 265

ROUTING SEQUENCE

	Initial	Date
Initiator	_____	_____
PM	_____	_____
QA	_____	_____

DISCREPANCY REPORT
PACE, INCORPORATED

DR. No. _____
(Obtain from QA)

DR. Code _____ QA USE:

INITIATOR: _____ DEPT: _____

CLIENT: _____ SUPERVISOR'S INITIALS: _____

PROJECT #: _____

SAMPLE(S): _____

ANALYSIS: _____

DISCREPANCY:

CORRECTIVE ACTION:

PROJECT MANAGER: _____ DATE: _____

PM COMMENTS:

CLIENT CONTACT: YES ( ) NO ( ) DATE: _____

CLIENT COMMENTS:

DISCREPANCY REPORT PROCEDURE

Attachment 2 (continued)

1. The Initiator completes the top half of the form.

2. The Initiator obtains a discrepancy report (DR) number from Quality Assurance (QA).

3. The Initiator writes the number in the "DR No." blank in the upper left-hand corner of the form.

4. The Initiator takes the form to the appropriate project manager (PM) to work out a solution and/or notify the client.

5. The PM writes his/her notes on the form and contacts the client if needed.

6. The PM notes any comments or resolutions achieved via client contact. PM completes bottom half of form.

7. The PM routes a copy of the completed form to the Initiator (or notifies the Initiator verbally) and routes the original to QA.

DISCREPANCY CODES

1. Holding Time
   - 1.0 Checked in out of holding
   - 1.1 Dilution run out of holding
   - 1.2 Arrived out of holding
   - 1.3 Short holding time parameter - sample arrived after hours
   - 1.4 Arrived after >50% holding time had expired.
   - 1.5 Miscellaneous
   - 1.6 Holding time not applicable to matrix

2. Lost Samples
   - 2.0 Sample misplaced during check-in.
   - 2.1 Sample misplaced during analysis.
   - 2.2 Miscellaneous

3. Preservation
   - 3.0 Not preserved
   - 3.1 Inadequately preserved (wrong type; insufficient)

4. Sample Volume
   - 4.0 Insufficient sample provided by client
   - 4.1 Insufficient sample as a result of analysis (VOA, Inorganic)
   - 4.2 Headspace present
   - 4.3 Extract final volume suspect

5. Lab Accident
   - 5.0 As a result of check-in/storage
   - 5.1 During Analysis

6. Contamination

7. Q.C. Outlier

7.0 Matrix
   - 7.1 Spiking error
   - 7.2 Instrumental

7.3 Preparation problem

8. Improper check-in of sample
   - 8.0 Client error

8.1 PACE error

9. Nonproject Related Discrepancy (i.e.; cooler out of control)

10. Miscellaneous

DISCREPANCY CODES

1. Holding Time Violation (lab delay)
2. Lost Samples
3. Preservation
4. Sample Volume
5. Lab Accident
6. Contamination
7. QC Outlier
8. Spiking Error
9. Sample Matrix
10. Miscellaneous
11. Holding Time Violation (client delay)

APPENDIX C-3

SAMPLE STORAGE SOP

74 270

STANDARD OPERATING PROCEDURE

Sample Storage

SOP NUMBER	ALL-Q-007-A
AUTHOR	Paul Ernst
EFFECTIVE DATE	December 3, 1991
SUPERSEDES	

APPROVAL

Rodney T. Miller — 2-18-92

Corporate Quality Assurance Officer — Date

Vice President, Quality/Technical Services — 2/24/92 Date

I. PURPOSE

A. The purpose of this Standard Operating Procedure is to establish a uniform procedure for the storage of samples and the maintenance of those storage areas in the laboratory.

II. APPLICATION

A. The policies and procedures contained in this SOP are applicable to any personnel who will at any time handle environmental samples received by the laboratory.

III. RESPONSIBILITIES

A. QUALITY ASSURANCE OFFICER

1. Responsible for distribution of this SOP.

2. Responsible for incorporating revisions to this SOP, as required.

B. DEPARTMENT SUPERVISOR/MANAGER

1. Responsible for ensuring the SOP is followed and samples are stored properly upon receipt.

2. Responsible for annual review of this SOP and reporting all required revisions to the Quality Assurance Officer.

C. SAMPLE CUSTODIANS/CHECK-IN TECHNICIANS

1. Responsible for storing all samples upon receipt in the appropriate storage area.

2. Responsible for maintaining a high level security for all samples.

3. Responsible for keeping a current inventory of all samples.

4. Responsible for maintaining the sample storage areas on a daily basis (see temperature log, Attachment 2), removal of old samples, and provision of space for incoming samples.

5. Responsible for transferring samples after analysis to appropriate storage locations.

IV. REVIEWS/REVISIONS

A. This SOP will be reviewed and/or revised on an annual basis at a minimum.

V. DISTRIBUTION

A. This SOP will be distributed to all personnel who will at any time handle environmental samples received by the laboratory.

VI. GENERAL PROCEDURES

A. Samples must be taken by the sample custodian to their storage location immediately upon receipt to prevent sample degradation.

B. All coolers are located in limited access areas of the building.

C. Sample Custodians will be assigned on a regionally specific basis, as required.

D. If a project requires strict internal chain of custody as described in SOP # ALL-Q-009-A, "Internal Chain of Custody," the Sample Custodian(s) will keep a log of sample numbers and indicate when samples were transferred and where the corresponding bottle types are stored using a Sample Control Record logbook (Attachment 1).

E. Sample storage locations before and during analysis will be designated on a regionally specific basis. Storage locations in the Minnesota region are listed in Appendix I.

VII. SPECIFIC PROCEDURES

A. Each region may code containers in a manner similar to the specific procedures that follow.

B. GENERAL SAMPLES

1. General samples are defined as unpreserved samples on which wet chemistry parameters are determined. Samples are kept in numerical order on trays in the appropriate storage location.

C. NITRO/OIL AND GREASE/PHENOL SAMPLES

1. These samples are preserved with H_2SO_4. Bottles are color coded with a gold dot and kept in numerical order on trays in the appropriate cooler.

D. CYANIDE SAMPLES

1. Containers used to store aqueous samples requiring cyanide determinations are preserved with NaOH. Bottles are color coded with a silver dot and kept in numerical order on trays in the appropriate cooler.

2. Soil samples are received unpreserved and stored under refrigeration in the appropriate cooler.

E. METALS SAMPLES, FILTERED AND UNFILTERED

1. Aqueous metals samples are preserved with HNO_3. Bottles are color coded with a red dot and kept in numerical order on trays on shelves in the appropriate non-refrigerated storage location. Filtered and unfiltered samples are stored on separate shelves or shelf areas.

2. Soil samples are received unpreserved and stored in the appropriate refrigerated area.

F. HAZARDOUS WASTE SAMPLES

1. Liquid and soil/solid samples are labeled with hazardous waste stickers and stored in numerical order in the designated hazardous waste storage area.

G. ORGANIC ANALYSIS SAMPLES

1. Volatile Organic:

a. Aqueous samples for volatile organic analyses are placed in vial boxes in numerical order and stored in the appropriate cooler.

b. Soil samples for volatile organic analyses are stored in numerical order in the appropriate cooler.

c. Samples for volatile organic analyses should not be stored in a cooler with samples for any other type of analysis.

2. Semi-Volatile Organic:

a. Samples for semi-volatile organic analyses are kept in numerical order in the appropriate cooler.

H. ASBESTOS SAMPLES

1. No refrigeration is required. Samples are taken to the asbestos lab for storage.

I. INDUSTRIAL HYGIENE (IH) SAMPLES

1. IH samples are taken directly to the appropriate storage area.

J. SAMPLES STORED UNDER STRICT CUSTODY (e.g., CLP)

1. All samples which require strict custody storage are inventoried when they are put into the appropriate locked storage area.

2. Analysts must sign out the samples under strict internal custody from the sample custodian (or designated personnel) using the ~~appropriate~~ Sample Control Record logbook (ICOC) in accordance with PACE, Inc. SOP number ALL-Q-007-A "Sample Storage" (see Attachment 1).

3. Storage areas containing samples requiring strict chain of custody will be clearly designated as follows:

   a. Secure storage areas may be designated to contain only strict chain of custody samples.

   b. Areas within a secure storage cooler may be labeled to designate storage of strict chain of custody.

   c. Trays, vial boxes, etc. may be labeled appropriately to designate storage of strict chain of custody samples.

4. Appendix II contains a list of designated personnel with access to secure storage areas in the Minnesota region.

VIII. REFERENCES

A. Contract Lab Program (CLP) Statement of Work for Organic and Inorganic Analyses, 3/90 Revision.

B. USEPA CLP Users Guide, 12/88 Revision.

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PACE
INCORPORATED
THE ASSURANCE OF QUALITY

CHAIN-OF-CUSTODY RECO
Analytical Request

Client

Address

Phone

Report To:

Bill To:

P.O. # / Billing Reference

Project Name / No.

Pace Client No.

Pace Project Manager

Pace Project No.

*Requested Due Date:

Sampled By (PRINT):

Sampler Signature

Date Sampled

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H_2SO_4	HNO_3	VOA			ANALYSES REQUEST	REMARKS
1	ATTACHMENT												
2													
3													
4													
5													
6													
7													
8													

COOLER NO'S	BAILERS	SHIPMENT METHOD OUT/DATE	SHIPMENT METHOD RETURNED/DATE

Additional Comments

ITEM NUMBER	RELINQUISHED BY / AFFILIATION	ACCEPTED BY / AFFILIATION	DATE	TIME

LENEXA, KS 66219 '74 278

ATTACHMENT 2

TEMP-CHEX™ TEMPERATURE RECORD

DEPT_____ TEMPERATURE RANGE_____ to _____ YEAR_____

MONTH:	JULY		AUG		SEP		OCT		NOV		DEC	
DAY:	RECORD	INITIAL	RECORD	INITIAL	RECORD	INITIAL	RECORD	INITIAL	RECORD	INITIAL	RECORD	INITIAL
1												
2												
3												
4												
5												
6												
7												
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30												
31												
REVIEW:												

ATTACHMENT 3 74 270

PACE, INCORPORATED
KANSAS REGIONAL OFFICE

INTERNAL SAMPLE CONTROL RECORD
REFRIGERATOR CODE _____

PACE SAMPLE #	STORED BY	DATE STORED	TIME STORED	REASON REMOVED	RETURN DATE	RETURN TIME	RETURN BY	COMMENTS

ATTACHMENT 4

CLP Sample and Extract Storage Locations

Refrigerator ID:	Location and Comments
R22	Northwest Hallway Contains VOC samples only Key maintained by sample custodian
R4	Extractions Laboratory Contains Semi-volatiles and Pesticide/PCB samples only Key maintained by Extractions Lead Analyst (Dana Monroe)
R2	Storage room south of Semi-volatiles laboratory Semi-volatile and Pesticide/PCB extracts only Key maintained by GC/MS Semi-volatile analyst (Mark Ross)

APPENDIX C-4

LABORATORY SECURITY PROCEDURES SOP

STANDARD OPERATING PROCEDURE

for

LABORATORY SECURITY PROCEDURES

SOP Number KS1-G-0101-A

Author Don Wright

Effective Date October 30, 1992

Supersedes 3

APPROVALS

Connie Gardner 11/18/92

Sample Check-In
Connie Gardner

Date

Don Wright 10/15/92

Quality Assurance Officer
Donald C. Wright Ph.D.

Date

Duane R. Boline 11/20/92

Regional Director
Duane R. Boline, Ph.D.

Date

74 283

LABORATORY SECURITY PROCEDURES

I. PURPOSE

The purpose of this SOP is to establish a procedure to ensure laboratory security for all entrances/exits to the Lenexa, Kansas facility.

II. APPLICATION

The exterior doors to the laboratory facility will remain locked and secure at all times, with the exception of the main front entrance in the receptionist area and the rear building receiving door at sample check-in during normal hours. The doors will be locked after normal working hours.

III. RESPONSIBILITIES

A. Personnel

The QAO is responsible for making sure that staff are alerted to this SOP. Keys to outside doors are maintained by the support service administrator.

B. Visitors

All visitors touring the facility are required to sign the visitors logbook at the receptionist desk, where a PACE badge and safety glasses are issued. Sample delivery persons admitted at the sample check-in area are escorted by PACE personnel during entry into the sample receiving area.

IV. REVIEWS/REVISIONS

A. QAO

The QAO is responsible for an annual review of this SOP.

V. DISTRIBUTION

Distribution of this SOP will be determined by the QAO and section supervisors.

VI. GENERAL POLICIES

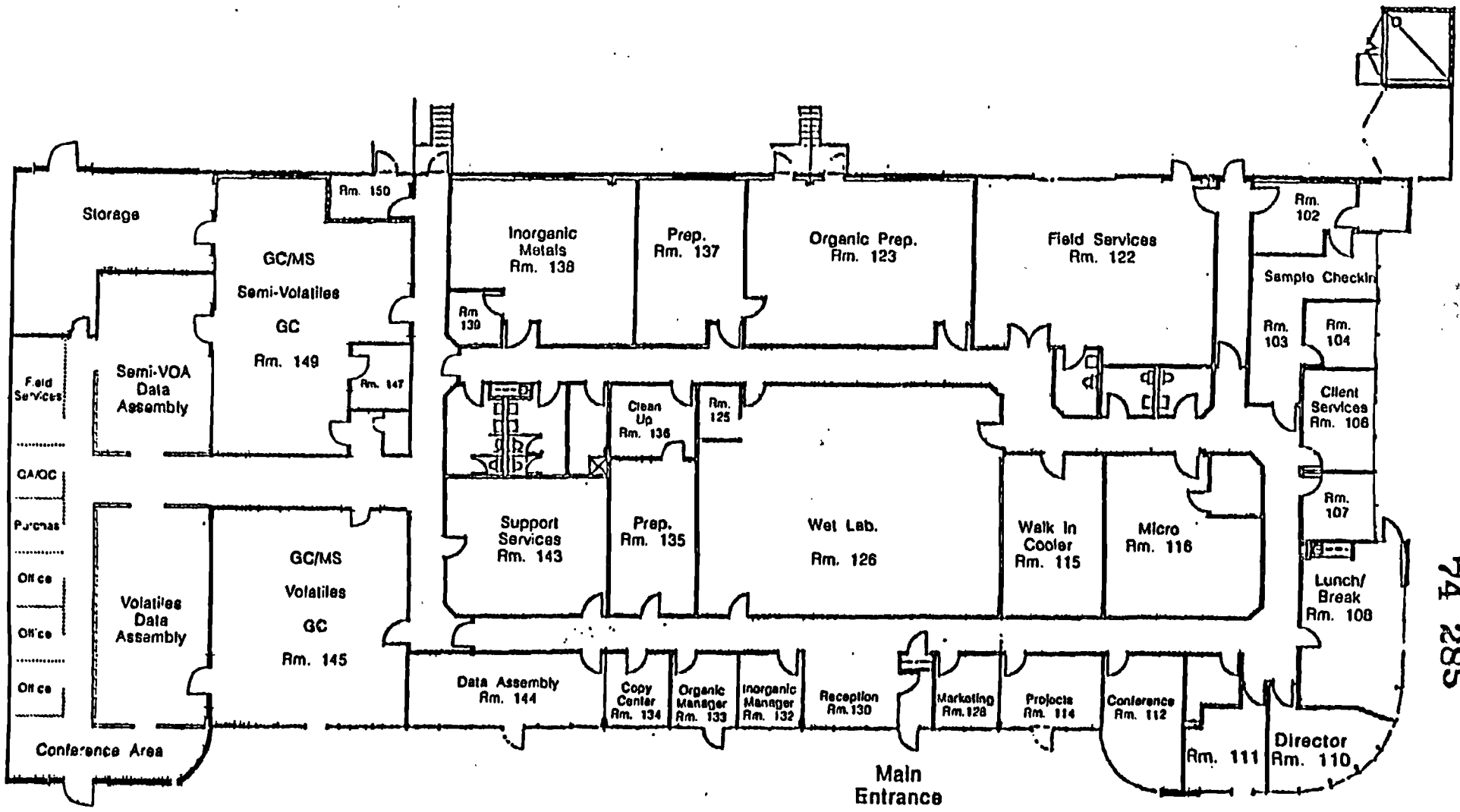
The PACE receptionist will request a signature from persons entering the front entrance of the building and issue a badge and safety glasses to all visitors. Personnel entering the building after hours are responsible for locking and securing entrance/exit doors after leaving the facility, including weekends.

VII. PROCEDURES

All entrance/exit doors have single key locks with inside turnbolt assemblies. If locks are modified or damaged, or require replacement, the support services supervisor is notified. A commercial locksmith is then called to maintance the lock.

VIII. REFERENCES

None



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Kansas Region

PACE, Incorporated
9608 Loiret
Lenexa, KS 66219

Phone: (913) 599 5665
Fax: (913) 599 1759

APPENDIX C-5

INTERNAL CHAIN-OF-CUSTODY SOP

74 287

STANDARD OPERATING PROCEDURE

Internal Chain of Custody

SOP NUMBER ALL-Q-009-A

AUTHOR Steve Crupi

EFFECTIVE DATE December 5, 1991

SUPERSEDES

APPROVAL

Rodney T Mills 2-19-92

Corporate Quality Assurance Officer Date

[signature] 2/20/92

Vice President, Quality/Technical Services Date

TABLE OF CONTENTS 74 288

INTERNAL CHAIN OF CUSTODY

I. PURPOSE

A. The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for logging samples into and out of storage, for internal custody transfers and for interregional transfer. Specific contractual obligations regarding internal chain of custody will supersede the procedures set forth in this document.

B. Internal chain of custody is established to provide unbroken tracking of the sample from the time it is received into the facility until the time of final disposition.

C. Internal chain of custody procedures as set forth in this document will be applied to projects requiring strict sample tracking in accordance with project contracts and to "routine" projects requiring minimal tracking.

II. RESPONSIBILITIES

A. PERSONNEL

1. All employees who at any time have custody of samples after being received by the laboratory are responsible for adherence to this SOP. A sample is under one's custody when it is in one's actual possession and when it is in one's view after being in one's physical possession

2. Employees are responsible for contacting their supervisor or the Quality Assurance Officer by written memo with any required revisions to this SOP.

B. SAMPLE CUSTODIAN/CHECK-IN PERSONNEL

1. Sample custodians are responsible for ensuring that all chain of custody forms (see Attachment 3) are signed at the time of sample receipt.

2. Sample Custodians are responsible for ensuring that samples received are properly logged into assigned storage areas.

C. DEPARTMENT MANAGERS

1. Department managers are responsible for ensuring adherence to the policies and procedures set forth in this SOP.

2. Department managers are responsible for providing adequate resources to allow the policies and procedures set forth in this SOP to be performed.

D. QUALITY ASSURANCE OFFICER (QAO)

1. The Quality Assurance Officer is responsible for the annual review of this SOP.

2. The Quality Assurance Officer is responsible for implementing all required revisions to this SOP at the time of SOP review.

3. The Quality Assurance Officer is responsible for determining distribution of this SOP and maintaining any distribution records.

4. The Quality Assurance Officer will monitor laboratory staff adherence to the policies and procedures set forth in this SOP.

III. REVIEWS/REVISIONS

A. See Section II, Part D, above.

IV. DISTRIBUTION

A. This document will be distributed to all laboratory personnel including sample receipt/check-in personnel, all analysts, and managers/supervisors/directors.

V. GENERAL POLICIES

A. The laboratories are restricted access areas. Access to the building is through a monitored reception area. In the MN Region, doors to the laboratory are accessible only by entering a code to unlock the door.

B. Visitors must register in a visitor's book in the reception area and be escorted while in the building. All visitors are required to wear identification badges.

C. Special instances may arise where an individual is not available to relinquish custody (e.g.- when separate shifts are preparing samples, or an analyst with custody calls in sick) and sample processing must continue. To deal with these situations and maintain sample integrity, an analyst assumes custody of a sample lot by ensuring that custody has not been broken and documenting this on the COC form. The explanation on the COC form might read, "I assumed custody of lot ABC from Jane Doe. The extracts were locked in the refrigerator with no evidence of tampering." The analyst would sign as receiver with the date, time, and purpose for the analyst assuming custody. These occurrences will be kept to a minimum (prior arrangements should be made for custody transfer if someone knows they will be unavailable).

D. In order to facilitate assembly of data packages, log book numbers and pages used may be included on a list in the data package.

E. Regionally specific chain of custody procedures will be included as Appendices (see Appendix I, "MN Custody Transfer").

F. Internal chain of custody (COC) of samples and sample extracts/digestates for CLP, HAZWRAP, USATHAMA and other programs must be maintained within the laboratory in addition to the field chain of custody received with the samples. The following protocol (and referenced forms) are to be used by sample preparation personnel or analysts in obtaining samples and by analysts in obtaining samples or extracts/digestates for analysis.

1. Samples and extracts/digestates are stored in designated secure areas. Samples are to be transferred to secure storage as soon as possible after receipt. Storage location for samples is given in PACE, Inc. SOP number ALL-Q-007-A (Sample Storage). Extracts are stored in a secure refrigerator located in the extraction lab or in secure refrigerators located in the organic laboratory areas. Metals samples and digestates are stored in secure rooms located in the inorganic laboratory areas. Refrigerators, freezers, and other sample storage areas are kept locked during non-business hours. Regular business hours are from 7:30 am to 5:30 pm Monday through Friday. If an analyst is present, locking the storage areas is not necessary.

2. Only the Sample Custodians or designated personnel have access to the secure storage area(s) (see Appendices II).

3. Samples and extracts/digestates remain in secure storage until removed for further sample preparation or analysis.

4. Bound Sample Control Record (SCR) books will be maintained for each type of project requiring internal COC. The books will be assigned a unique number, be paginated, and the book number will be written on each page. See Attachment 1 for an example of the SCR logbook page.

VI. PROCEDURE FOR INTERNAL CHAIN OF CUSTODY

A. All samples are inventoried in the appropriate SCR book as they are put into a secure storage area. When samples are needed for analysis, the analyst notifies the Sample Custodian (or designee) and the following information is recorded in the SCR book by the Sample Custodian:

1. Sample Number (required)

   a. The unique LDMS laboratory sample number assigned at receipt. Enter the individual number or first and last number for a consecutive series of samples.

2. Relinquished by/Received by (required)

   a. The initials of the individual relinquishing the samples and the initials of the individual receiving the samples must be entered in this column.

   b. In the case of relinquishing or receiving custody from a storage area, the appropriate columns will be completed.

3. Date and Time Removed/Date and Time Returned (required)

   a. This column contains the date and time the samples are relinquished and received by the Sample Custodian.

4. Reason (required)

   a. This column is used to record the reason for removing the samples from the secure area.

   b. If custody is changed within a department without returning the sample/fraction(s) to secure storage, this will be documented in this column. For internal transfers, include the initials of the person relinquishing custody, the person assuming custody and the time when the transfer occurred.

   c. Codes as shown on the bottom of the SCR form, may be used to indicate reason for transfer.

B. Upon completion of sample preparation, the extracts/digestates are logged into either the Sample Extract Control Logbook or the Sample Digestate Control Logbook according to the extract/digestate ID number. See Attachment 2 and 4 for an example of each of these logbook pages. Extracts are kept for 400 days from the date of sample receipt or the number of days required by specific contracts.

C. All transfers of samples and extracts/digestates into and out of storage will be documented in their respective logbooks.

   1. The control records for samples are maintained by the Sample Custodian (or designated personnel).

2. After a sample has been removed from storage by the Sample Custodian and relinquished to the analyst (or the analyst assumes custody from a secured refrigerated storage area), the analyst is responsible for the custody of the sample. Each analyst must return the samples to the sample storage area. The applicable logbook pages must be again initialed by the analyst and the Sample Custodian to transfer custody.

3. If an internal department or interregional transfer of samples is necessary, this is documented in the "Reason" column.

VII. REFERENCES

A. Contract Lab Program (CLP) Statement of Work of Organic and Inorganic Analyses, 3/90 Revisions

B. USEPA CLP User's Guide, 12/88 Revision

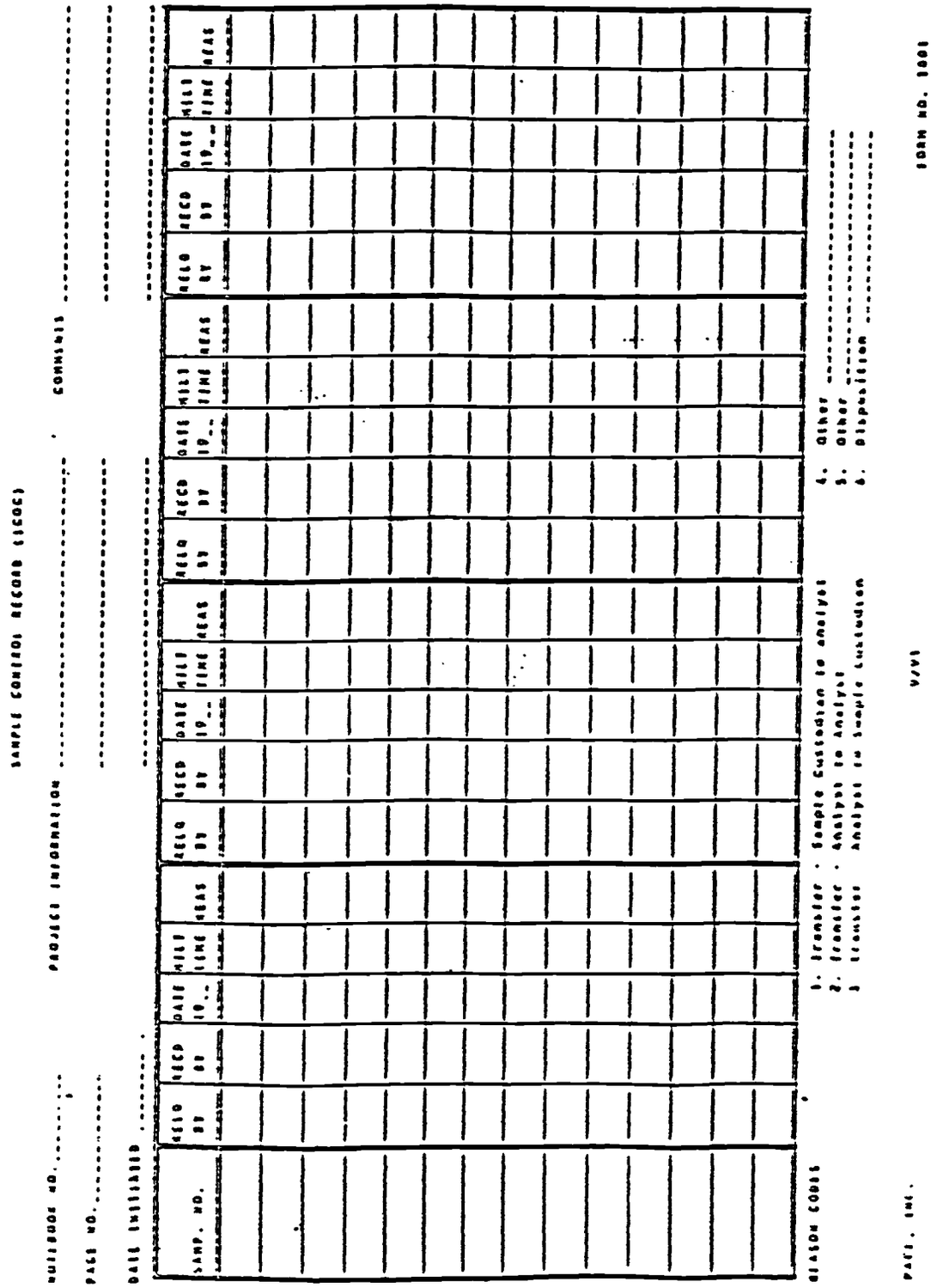
C. U.S. Army Toxic and Hazardous Materials Agency's Quality Assurance Program, January 1990.

VIII. ATTACHMENTS

A. Regionally specific attachments may be included in this document. Appendices specific to regional protocols/procedures may also be included.

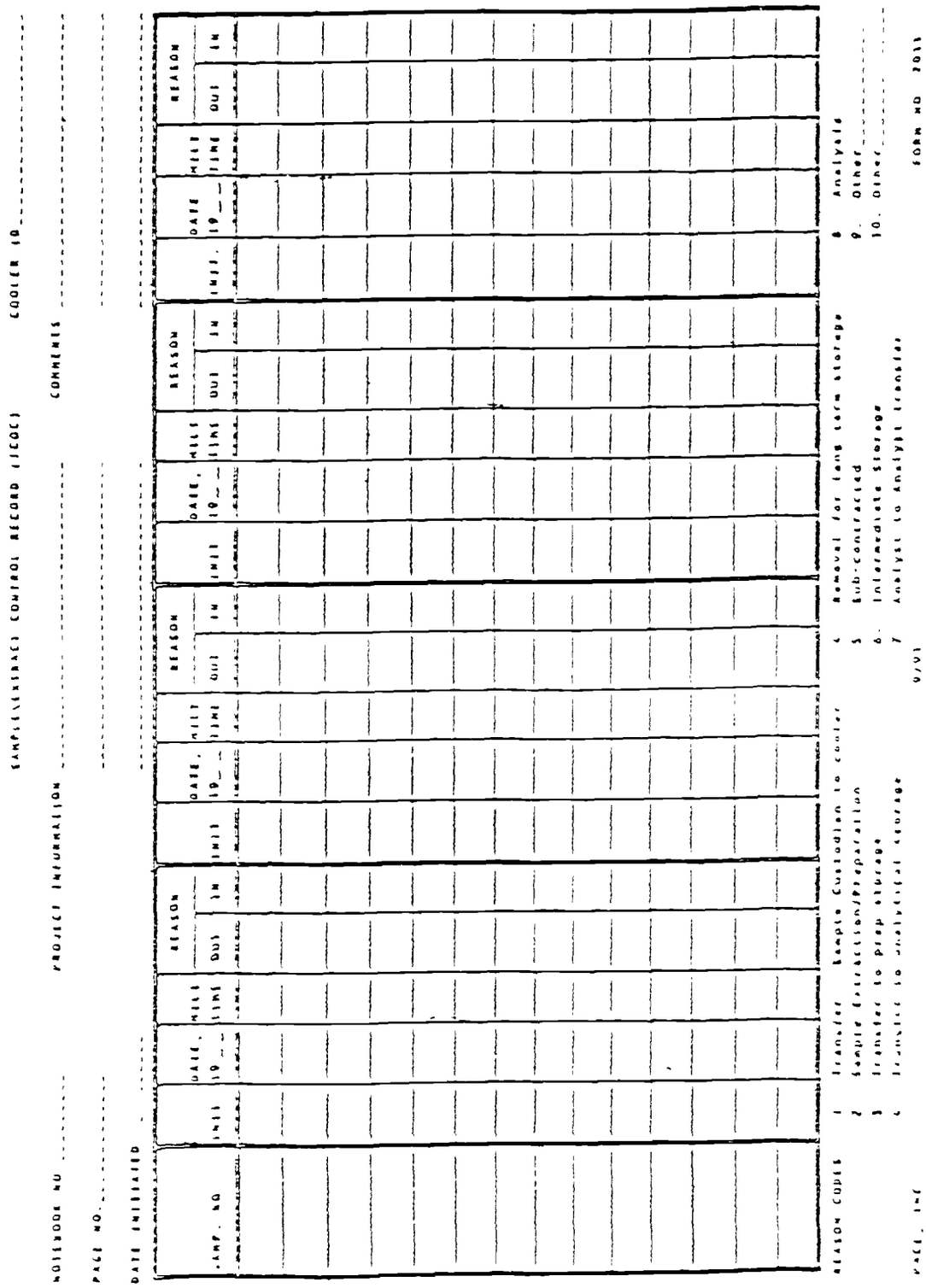
Attachment 1

Sample Control Record



Attachment 2

Sample Extract/Digestate Control Record



Attachment 3

Internal Chain of Custody Form

pace
INCORPORATED
THE ASSURANCE OF QUALITY

44804

CHAIN-OF-CUSTODY RECORD
Analytical Request

Report To
Bill To:
PO # / Billing Reference
Project Name / No.

Pace Client No
Pace Project Manager
Pace Project No
*Requested Due Date

Sampled By (PRINT)
Sampled Signature
Date Sampled

ITEM NO.	SAMPLE DESCRIPTION	TIME	MATRIX	PACE NO.	NO. OF CONTAINERS	PRESERVATIVES: UNPRESERVED	H_2SO_4	HNO3	HCl			ANALYSES REQUEST	REMARKS
1													
2													
3													
4													
5													
6													
7													
8													

COOLER NOS.	BAILERS	SHIPMENT METHOD OUT / DATE	SHIPMENT METHOD RETURNED / DATE

Additional Comments

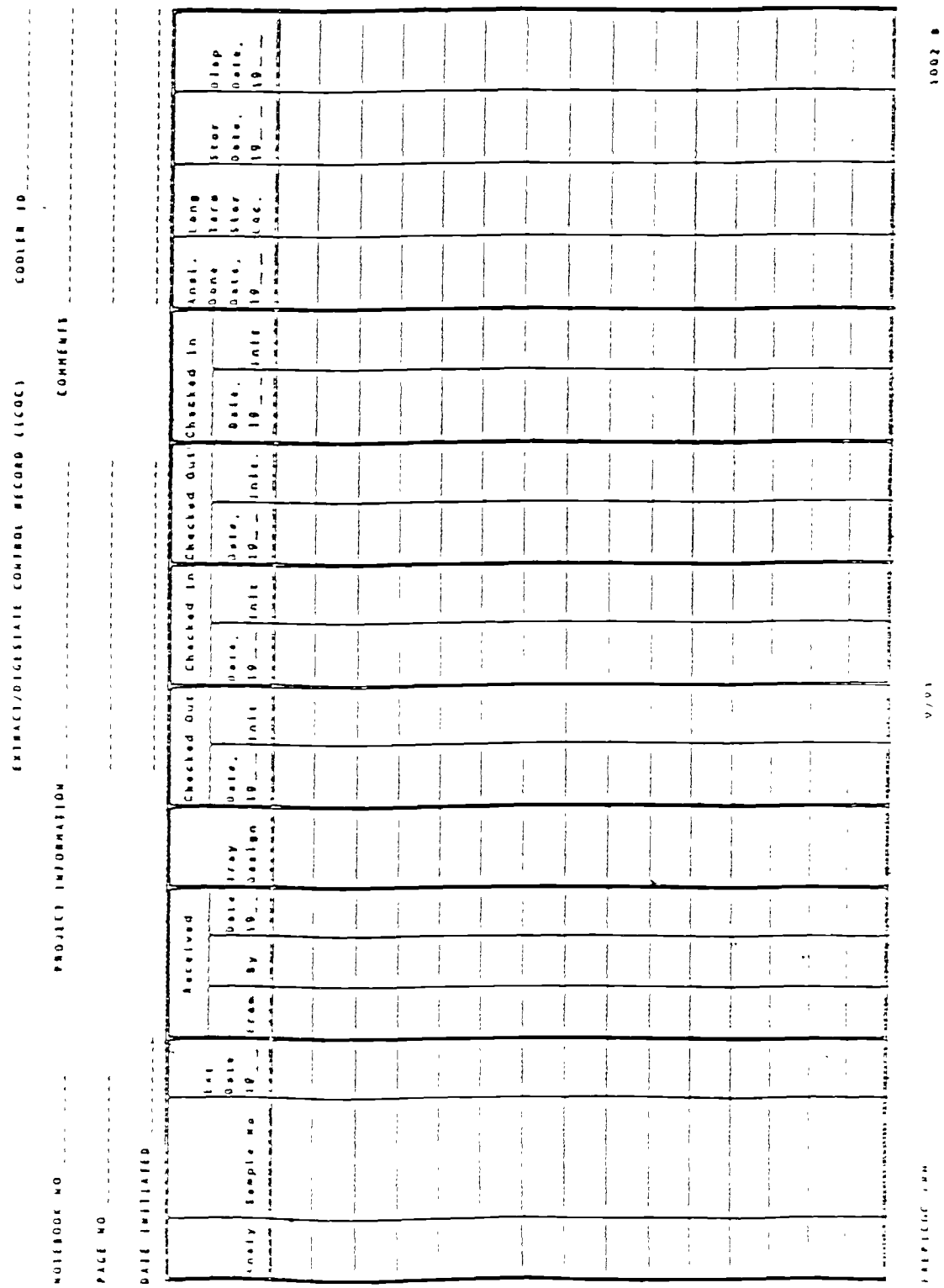
ITEM NUMBER	RELINQUISHER BY / AFFILIATION	ACCEPTER BY / AFFILIATION	DATE	TIME

ORIGINAL

SEE REVERSE SIDE FOR INSTRUCTIONS

Attachment 4

Extract/Digestate Control Record



pace
INCORPORATED
THE ASSURANCE OF QUALITY

74 300

PACE EXTRACTION DATA

PROJECT #:

SS:	AMT:	CONC:	ANALYST:	EXT DATE:		EXT BY:	
MS:	AMT:	CONC:	ANALYST:	ANALYSIS:		BATCH #:	

SAMPLE ID	IV OR IW	pH		% MOIST	SPIKE VER	DATE CONC (by)	CONC TUBE #	CLEAN UP	FINAL VOL	FINAL SOL	COMMENTS
		INIT	ADJ								

EXT SOLVENT_____ BRAND_____ LOT #_____

EXCHANGE SOLVENT_____ BRAND_____ LOT #_____

OTHER SOLVENT_____ BRAND_____ LOT #_____

SAMPLE MATRIX_____ EXT METH (SON,SOX,SEP,CLLE)_____

REAGENTS

SOP

COMMENTS

REVIEWED BY:_____ DATE:_____ FORM ID_____

PACE EXTRACTION SHEET INSTRUCTIONS
(INTERREGIONAL FORM)

	ITEM	FILL-IN	DEFINITION
1.			
2.	Proj. No.	Optional	LDMS Generated No.
3.	Client ID#	Optional	LDMS Client Code
4.	Client	Optional	Client Company Name
5.	SS	Mandatory	Surrogate ID #
6.	MS	Mandatory	Matrix Spike ID #
7.	Amt.	Mandatory	Volume Added
8.	Conc.- (Multi-compound)	Mandatory	Concentration Units -Copy of notebook page required when using multiple concentrations
9.	Analyst	Mandatory	Analyst's Initials (all involved)
10.	Ext Date	Mandatory	Date Analysis Initiated
11.	Ext. By	Mandatory	Analyst's Initials (all involved)
12.	Analysis	Mandatory	Copy of Special Method May Be Requested
13.	Batch #	Mandatory	LDMS QC Batch # (or lab batch #)
14.	Sample ID	Mandatory	LDMS Generated No.
15.	Iv or IW	Mandatory	Initial Start Volume or Wet Weight - Include units.
16.	pH Initial	Mandatory	Initial Sample pH (water only)
17.	pH Adjusted	Mandatory	Adjusted Sample pH
18.	% Moist	Mandatory	Solids Only. Final Value for Moisture (%). Report "as is" unless requested for routine
19.	Spike Ver.	Optional	Checkmark or Initial of Witness
20.	Date Conc. (by)	Optional	Date and Analyst Initials Concentration of Extract Complete
21.	Conc. Tube #	Optional	Number of Etched Tube
22.	Clean Up	Optional	GPC, Column Cleanup (if required)
23.	Final Volume	Mandatory	Final Extract Volume (mL)
24.	Final Sol.	Optional	Final Volume of Solvent Exchange (if applicable)
25.	Comments	Optional	Any Commentary Describing Individual Samples
26.	Extraction Solvent	Mandatory	Chemical Solvent Name
27.	Exchange Solvent	Mandatory	Chemical Solvent Name
28.	Other Solvent	Optional	Chemical Solvent Name
29.	Sample Matrix	Mandatory	Liquid, Solid
30.	Brand	Mandatory	Vendor Supplier Name
31.	Lot #	Mandatory	Manufacturer Lot #
32.	Reagents	Mandatory	Sodium Sulfate, Aluminum, etc.
33.	Ext. Method	Mandatory	Sonication, Soxhlet, Sep etc.
34.	SOP Followed	Optional	List PACE SOP Doc. Number
35.	Comments	Optional	Project Specific Comments, Can Attach Page if Necessary. Color, Odor, etc.
36.	Reviewed by	Mandatory	Analysts Supervisor
37.	Date	Mandatory	Review Date

APPENDIX C-6

METHOD AND INSTRUMENT DETECTION LIMITS

PACE-KS
METHOD DETECTION LIMITS AND QUANTITATION LIMITS

Analysis Method	Metal	PACE MDL WATER	PACE MDL SOIL	PACE PQL WATER	PACE PQL SOIL
6010	Aluminum	0.010 mg/L	1 mg/kg	0.05 mg/L	5 mg/kg
	Barium	0.011 mg/L	1.1 mg/kg	0.01 mg/L	1 mg/kg
	Beryllium	0.0009mg/L	0.9 mg/kg	0.001 mg/L	0.1 mg/kg
	Cadmium	0.005 mg/L	0.5 mg/kg	0.005 mg/L	0.5 mg/kg
	Calcium	0.034 mg/L	3.4 mg/kg	0.1 mg/L	10 mg/kg
	Chromium	0.004 mg/L	0.4 mg/kg	0.02 mg/L	2 mg/kg
	Cobalt	0.037 mg/L	3.7 mg/kg	0.05 mg/L	5 mg/kg
	Copper	0.004 mg/L	0.4 mg/kg	0.01 mg/L	1 mg/kg
	Iron	0.030 mg/L	3 mg/kg	0.05 mg/L	5 mg/kg
	Magnesium	0.035 mg/L	3.5 mg/kg	0.1 mg/L	10 mg/kg
	Manganese	0.001 mg/L	0.1 mg/kg	0.01 mg/L	1 mg/kg
	Molybdenum	0.077 mg/L	7.7 mg/kg	0.1 mg/L	10 mg/kg
	Nickel	0.012 mg/L	1.2 mg/kg	0.05 mg/L	5 mg/kg
	Potassium	2.000 mg/L	200 mg/kg	1 mg/L	100 mg/kg
	Silver	0.005 mg/L	0.5 mg/kg	0.03 mg/L	3 mg/kg
	Sodium	0.124 mg/L	12.4 mg/kg	0.2 mg/L	20 mg/kg
	Vanadium	0.036 mg/L	3.6 mg/kg	0.05 mg/L	5 mg/kg
	Zinc	0.006 mg/L	0.6 mg/kg	0.02 mg/L	2 mg/kg
7041	Antimony	2.4 ug/L	0.24 mg/kg	10 ug/L	1 mg/kg
7060	Arsenic	2.4 ug/L	0.24 mg/kg	5 ug/L	0.5 mg/kg
7740	Selenium	2.4 ug/L	0.24 mg/kg	5 ug/L	0.5 mg/kg
7470	Mercury	0.2 ug/L	–	0.2 ug/L	–
7471	Mercury	–	0.1 mg/kg	–	0.5 mg/kg
7421	Lead	2 ug/L	0.2 mg/kg	5 ug/L	0.5 mg/kg
7841	Thallium	1.5 ug/L	0.15 mg/kg	10 ug/L	1 mg/kg

Quantitation and Detection Limits for Target Analytes
PACE, Inc., Kansas

Method	Parameter	Quantitation Limit		Method Detection Limit	
		Water (ug/L)	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)
EPA SW-846 8015 Mod.	Gasoline	400	5	200	5
	Diesel	400	5	200	5
	Jet Fuel	400	5	200	5

METHOD DETECTION AND QUANTITATION LIMITS

PESTICIDES AND PCBS, SW 8080

Parameter	Maximum Allowable Quantitation Limits(1)		PACE - Quant Limits		PACE MDL	
	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg
Aldrin	0.04	0.0015	0.04	0.0015	0.05	0.0009
alpha-BHC	0.03	0.0015	0.03	0.0015	0.03	0.0013
beta-BHC	0.05	0.0015	0.05	0.0015	0.05	0.0008
delta-BHC	0.05	0.0015	0.05	0.0015	0.04	0.0015
gamma-BHC (Lindane)	0.04	0.0015	0.04	0.0015	0.04	0.0011
Chlordane	0.05	0.0015	0.05	0.0015	0.04	0.0007
4,4'-DDD	0.1	0.003	0.1	0.003	0.1	0.0010
4,4'-DDE	0.04	0.003	0.09*	0.003	0.1	0.0016
4,4'-DDT	0.1	0.003	0.1	0.003	0.09	0.0027
Dieldrin	0.05	0.003	0.05	0.003	0.05	0.0015
Endosulfan I	0.05	0.0015	0.05	0.0015	0.04	0.0007
Endosulfan II	0.1	0.003	0.1	0.003	0.09	0.0019
Endosulfan Sulfate	0.1	0.003	0.1	0.003	0.09	0.0019
Endrin	0.06	0.003	0.06	0.003	0.06	0.0019
Endrin aldehyde	0.1	0.003	0.1	0.003	0.09	0.0011
Heptachlor	0.03	0.002	0.03	0.002	0.03	0.0003
Heptachlor epoxide	0.05	0.002	0.05	0.002	0.04	0.0008
Methoxychlor	0.5	0.015	0.5	0.015	0.46	0.010
Toxaphene	2.5	0.16	2.5	0.16	2.5	0.16
PCB-1016	1.0	0.03	1.0	0.03	1.0	0.03
PCB-1221	1.0	0.03	1.0	0.03	1.0	0.03
PCB-1232	1.0	0.03	1.0	0.03	1.0	0.03
PCB-1242	1.0	0.03	1.0	0.03	1.0	0.03
PCB-1248	1.0	0.03	1.0	0.03	1.0	0.03
PCB-1254	1.0	0.03	1.0	0.03	1	0.03
PCB-1260	1.0	0.03	1.0	0.03	1	0.03

* Variance for this compound was requested and granted for the March AFB project.

METHOD DETECTION AND QUANTITATION LIMITS

VOLATILE COMPOUNDS, SW 8240

Parameter	Maximum Allowable Quantitation Limits(1)		PACE - Quant Limits		PACE MDL	
	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg	Water ug/L	Soil ug/k
Acetone	10	0.010	10	0.026*	8	3
Benzene	5	0.005	5	0.005	1	
Bromodichloromethane	5	0.005	5	0.005	1	2
Bromoform	5	0.005	5	0.005	5	
Bromomethane	10	0.010	10	0.010	3	
2-Butanone(MEK)	10	0.010	10	0.026*	9	26
Carbon disulfide	5	0.005	5	0.005	2	5
Carbon tetrachloride	5	0.005	5	0.005	1	
Chlorobenzene	5	0.005	5	0.005	2	
Dibromochloromethane	5	0.005	5	0.005	3	1
Chloroethane	10	0.010	10	0.010	3	
2-Chloroethyl vinyl ether	10	0.010	10	0.010	5	3
Chloroform	5	0.005	5	0.005	2	
Chloromethane	10	0.010	10	0.029*	3	2
1,1-Dichloroethane	5	0.005	5	0.005	2	2
1,2-Dichloroethane	5	0.005	5	0.005	2	3
1,2-Dichloroethene	5	0.005	5	0.005	3	
trans-1,2-Dichloroethene	5	0.005	5	0.005	2	
1,2-Dichloropropane	5	0.005	5	0.005	1	2
cis-1,3-Dichloropropene	5	0.005	5	0.005	1	
trans-1,3-Dichloropropene	5	0.005	5	0.005	3	
Ethylbenzene	5	0.005	5	0.005	1	1
2-Hexanone	10	0.010	10	0.011*	10	11
Methylene chloride	5	0.005	5	0.005	2	4
4-Methyl-2-pentanone (MIBK)	10	00.10	10	00.10	9	6
Styrene	5	0.005	5	0.005	1	2
1,1,2,2-Tetrachloroethane	5	0.005	5	0.005	7	3
Tetrachloroethene	5	0.005	5	0.005	2	1
Toluene	5	0.005	5	0.005	1	1
1,1,1-Trichloroethane	5	0.005	5	0.005	2	1
1,1,2-Trichloroethane	5	0.005	5	0.005	4	2
Trichloroethene	5	0.005	5	0.005	2	1
Vinyl acetate	10	0.010	10	0.010	5	10
Vinyl chloride	10	0.010	10	0.010	3	7
Xylenes (Total all isomers)	5	0.005	5	0.005	3	2
1,1-Dichloroethene	5	0.005	5	0.005	2	3

* Variance for these compounds was requested and granted for the March AFB project.

(1) Air Force May 1991

METHOD DETECTION AND QUANTITATION LIMITS

SEMI-VOLATILE ORGANIC COMPOUNDS, SW 8270

Parameter	Maximum Allowable Quantitation Limits(1)		PACE - Quant Limits		PACE MDL	
	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg
Acenaphthene	10	0.3	10	0.3	6	0.2
Acenaphthylene	10	0.3	10	0.3	8	0.3
Anthracene	10	0.3	10	0.3	6	0.2
Benzo(a)anthracene	10	0.3	10	0.3	4	0.3
Benzo(b)fluoranthene	10	0.3	10	0.3	8	0.5
Benzo(k)fluoranthene	10	0.3	10	0.3	4	0.6
Benzo(ghi)perylene	10	0.3	10	0.4	6	0.4
Benzo(a)pyrene	10	0.3	10	0.3	8	0.3
Benzyl alcohol	10	0.3	10	0.3	8	0.3
bis(2-Chloroethoxy) methane	10	0.3	10	0.3	5	0.2
bis(2-Chloroethyl)ether	10	0.3	10	0.3	8	0.3
bis(2-Chloroisopropyl) ether	10	0.3	10	0.3	-	0.3
bis(2-ethylhexyl) phthalate	10	0.3	10	0.3	-	0.3
4-Bromophenyl phenyl ether	10	0.3	10	0.3	10	0.3
Butyl benzyl phthalate	10	0.3	10	0.3	6	0.4
4-Chloroaniline	10	0.3	10	0.3	10	0.3
2-Chloronaphthalene	10	0.3	10	0.3	8	0.3
4-Chlorophenyl phenyl ether	10	0.3	10	0.3	9	0.3
Chrysene	10	0.3	10	0.3	4	0.3
Dibenz (a,h) anthracene	10	0.3	10	0.3	4	0.3
Dibenzofuran	10	0.3	10	0.3	6	0.3
Di-n-butylphthalate	10	0.3	10	0.3	8	0.3
1,2-Dichlorobenzene	10	0.3	10	0.3	8	0.3
1,3-Dichlorobenzene	10	0.3	10	0.3	10	0.3
1,4-Dichlorobenzene	10	0.3	10	0.3	9	0.3
3,3-Dichlorobenzidine	20	0.6	20	0.6	10	0.4
Diethyl phthalate	10	0.3	10	0.3	4	0.3
Dimethyl phthalate	10	0.3	10	0.3	8	0.3
2,4-Dinitrotoluene	10	0.3	10	0.3	8	0.3
2,6-Dinitrotoluene	10	0.3	10	0.3	8	0.3
Di-n-octyl phthalate	10	0.3	10	0.3	9	0.4
Fluoranthene	10	0.3	10	0.3	6	0.2

1. Air Force May 1991

METHOD DETECTION AND QUANTITATION LIMITS

SEMI-VOLATILE ORGANIC COMPOUNDS, SW 8270

Parameter	Maximum Allowable Quantitation Limits(1)		PACE - Quant Limits		PACE MDL	
	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg	Water ug/L	Soil mg/kg
Fluorene	10	0.3	10	0.3	8	0.2
Hexachlorobenzene	10	0.3	10	0.3	10	0.3
Hexachlorobutadiene	10	0.3	10	0.3	10	0.3
Hexachlorocyclo-pentadiene	10	0.3	10	0.3	5	0.7
Hexachloroethane	10	0.3	10	0.3	8	0.3
Indeno(1,2,3-cd)pyrene	10	0.3	10	0.3	6	0.6
Isophorone	10	0.3	10	0.3	5	0.2
2-Methylnaphthalene	10	0.3	10	0.3	4	1.2
Naphthalene	10	0.3	10	0.3	5	0.3
2-Nitroaniline	50	1.6	50	1.6	8	0.6
3-Nitroaniline	50	1.6	50	1.6	12	0.5
4-Nitroaniline	50	1.6	50	1.6	19	1.2
Nitrobenzene	10	0.3	10	0.3	11	0.3
n-Nitrosodiphenylamine	10	0.3	10	0.3	7	0.3
n-Nitrosodipropylamine	10	0.3	10	0.3	9	0.3
Phenanthrene	10	0.3	10	0.3	7	0.2
Pyrene	10	0.3	10	0.3	15	0.4
1,2,4-Trichlorobenzene	10	0.3	10	0.3	9	0.3
Acid Extractables						
Benzoic Acid	50	1.6	50	1.6	14	0.6
4-Chloro-3-methylphenol	10	0.3	10	0.3	6	0.2
2-Chlorophenol	10	0.3	10	0.3	9	0.3
2,4-Dichlorophenol	10	0.3	10	0.3	6	0.2
4,6-Dinitro-2-methylphenol	50	1.6	50	1.6	7	0.6
2,4-Dimethylphenol	10	0.3	10	0.3	5	0.2
2,4-Dinitrophenol	50	1.6	50	1.6	18	0.3
2-Methylphenol	10	0.3	10	0.3	8	0.3
4-Methylphenol	10	0.5	10	0.5	8	0.3
2-Nitrophenol	10	0.3	10	0.3	6	0.2
4-Nitrophenol	50	1.6	50	1.6	5	0.4
Pentachlorophenol	30	1.0	30	1.0	8	0.7
Phenol	10	0.3	10	0.3	5	0.3
2,4,5-Trichlorophenol	50	1.6	50	1.6	7	0.3
2,4,6-Trichlorophenol	10	0.3	10	0.3	8	0.3

(1) Air Force May 1991

MDL AND PQL TABLE

74 309

CHLORINATED PHENOXY ACID HERBICIDES, SW 8150

Analyte	WATER MDL ug/L	WATER PQL ug/L	SOIL MDL mg/kg	SOIL PQL mg/kg
2,4-D	5.4	10	0.06	0.80
2,4-DB	5.6	9	0.07	0.60
2,4,5-T	0.5	1	0.007	0.10
2,4,5-TP	0.1	1	0.005	0.10
Dalapon	1.7	25	0.07	4.0
Dicamba	0.5	1	0.004	0.20
Dichloroprop	4.9	6.5	0.05	0.50
Dinoseb	3.1	3.1	0.13	0.65
MCPA	470	1000	2.9	130
MCPP	400	1000	2.2	170

	EPA METHOD 1311				
	Toxic Characteristics Leaching Procedure				
Regulated Substances	EPA Method	Regulatory Limit mg/L	MDL mg/L	PQL mg/L	
Metals					
Arsenic	6010	5	TBD	0.25	
Barium	6010	100	0.011	5	
Cadmium	6010	1	0.005	0.05	
Chromium	6010	5	0.004	0.25	
Lead	6010	5	TBD	0.25	
Selenium	6010	1	TBD	0.25	
Silver	6010	5	0.005	0.25	
Mercury	7470	0.2	0.00007	0.01	
Regulated Substances	EPA Method	Regulatory Limit mg/L	MDL* mg/L	PQL* mg/L	
Pesticides	8080				
Chlordane		0.03	0.0004	0.0005	
Endrin		0.02	0.0006	0.0006	
Heptachlor		0.008	0.0004	0.0004	
Heptachlor epoxide		0.008	0.0004	0.0005	
Lindane		0.4	0.0005	0.0005	
Methoxychlor		10	0.0046	0.005	
Toxaphene		0.5	0.025	0.025	
Herbicides	8150				
2,4-D		10	0.054	0.1	
2,4,5-TP (Silvex)		1	0.001	0.01	

	EPA Method	Regulatory Limit mg/L	MDL* mg/L	PQL* mg/L
Volatile Organics	8240			
Benzene		0.5	0.02	1
Carbon Tetrachloride		0.5	0.02	0.1
Chloroform		100	0.04	0.1
1,2-Dichloroethane		6	0.04	0.1
1,1-Dichloroethylene		0.5	0.04	0.1
Methyl ethyl ketone		0.7	0.18	0.2
Tetrachloroethylene		200	0.04	0.1
Trichloroethylene		0.7	0.04	0.1
Vinyl Chloride		0.2	0.06	0.2
Semivolatile Organics	8270			
o-Cresol		200	0.08	0.1
m-Cresol		200	0.08	0.1
p-Cresol		200	0.08	0.1
1,4-Dichlorobenzene		7.5	0.09	0.1
2,4-Dinitrotoluene		0.13	0.05	0.1
Hexachlorobenzene		0.13	0.1	0.1
Hexachloro-1,3-butadiene		0.5	0.1	0.1
Hexachloroethane		3	0.08	0.1
Nitrobenzene		2	0.1	0.1
Pentachlorophenol		100	0.08	0.1
Pyridine		5	0.1	0.1
2,4,5-Trichlorophenol		400	0.07	0.5
2,4,6-Trichlorophenol		2	0.08	0.1

* The MDL and PQL values for organic compounds are based upon the analyses of aqueous standards per the EPA recommended procedure. The values in this table represent a 1:10 dilution of the TCLP leachate analyzed for extractable organics and a 1:20 dilution of the TCLP Leachate analyzed for volatile organics. This dilution is necessary to minimize the matrix effect of the TCLP leaching solution.

Each TCLP leachate is analyzed inconjunction with a preparation blank, LCS, and a Matrix spiked leachate. The acceptance criteria for the blank and LCS are as presented for the respective analysis methods. There is not a specified acceptance criteria for a matrix spike solution due to the wide variety of matrices analyzed by this method.

Each sample is spiked with surrogate compounds per the protocols for the analyses of aqueoues samples.